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USSR Report

MATERIALS SCIENCE AND METALLURGY

No. 84

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USSR REPORT

MATERIALS SCIENCE AND METALLURGY

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CONTENTS

 [III - USSR - 21G S&T]

MAGNESIUM

MINERALS

NONFERROUS METALLURGY

POWDER METALLURGY

SINGLE CRYSTALS

THIN FILMS

TITANIUM

ALUMINUM AND ITS ALLOYS

DEVELOPMENT OF SOVIET ALUMINUM INDUSTRY

Moscow PRAVDA in Russian 13 Jun 82

[Article by P. Lomako, USSR minister of nonferrous metallurgy: "Winged Metal"]

[Text] A brief news item appeared in PRAVDA in mid-May 1932: "The Volkhov Aluminum Combine has turned out the first ingots of Soviet-produced aluminum." This piece of news about organization of Soviet production of the "winged metal" spread rapidly throughout the country. Soviet citizens realized its enormous importance for successful development of all sectors of the economy and for meeting defense needs.

GOELRO, Lenin's plan for electrification of Russia, became the foundation for organizing this energy-intensive industry. We could not allow our industry, particularly the aircraft industry, to be dependent on supply of aluminum from capitalist countries. The 15th Party Congress made the decision to develop a domestic aluminum industry. Plans called for building a first plant in Volkhov, to be accomplished as quickly as possible. The Volkhov GES was its source of electric power, high-silicon Tikhvin bauxites were its raw materials, and Soviet scientists proposed the technology for processing these bauxites. The All-Union Soyuzalyuminiy Association and two specialized institutes, subsequently consolidated into a single comprehensive branch All-Union Scientific Research and Design Institute of the Aluminum, Magnesium and Electrode Industry -- VAMI -- were established to manage this new subbranch.

Construction of the Volkhov Aluminum Plant began in May 1930. Construction and installation were conducted simultaneously. The plant was erected in unprecedentedly short time -- only 2 years. Soon aluminum was also being produced at the Dneprovskiy Plant, which became a genuine laboratory for the development of new products and high-output electrolytic cells. This plant produced the world's first silicon-aluminum alloy in ore roasting furnaces and began the production of Soviet silicon.

The Tikhvin Alumina Plant came on-stream during those same years. A reliable raw materials base for the new subbranch was established in the east. Geologists discovered large bauxite deposits in the Urals, where the Urals Aluminum Plant was built in short order, a plant which during the difficult war years assumed the brunt of the burden of producing "winged metal."

The Novokuznetsk and Bogoslovskiy aluminum plants were built during the war years, under incredibly difficult conditions. Soon the subbranch had not only reestablished its lost production capacity but had exceeded the prewar output level. This was a result of enormous patriotic and labor enthusiasm by Soviet citizens. Enterprise workforces time and again earned the challenge Red Banner of the State Defense Committee. Their experience later came in handy in building the Kanakerskiy, Kandalaksha, Nadvoitsy, Sumgait, and Volgograd aluminum plants and the Southern Urals Cryolite Plant. The Ikrutsk, Krasnoyarsk, and Bratsk aluminum plants, powered by the mighty electric power stations of Eastern Siberia, were built with shock-work labor.

With the construction of new plants, creation of a reliable raw materials base became a most important problem. Geologists, miners and metallurgists were enlisted to solve this problem. Prospecting and exploration activities were expanded in order to increase bauxite reserves for the mining enterprises of the Urals and Kazakhstan and to discover new deposts. Much had already been accomplished. For the first time anywhere in the world, problems connected with utilizing nonbauxite raw material and low-grade bauxites had been successfully solved.

For the first time anywhere in the world, combined processing of Kola nepheline concentrates was accomplished at the Volkhov Aluminum Plant and the Pikalevo Aluminum Plant, producing alumina, soda ash, potash, and cement. The Kirovabad Aluminum Plant began processing alunite ore mined in the Azerbaijan SSR. The Pavlodar Aluminum Plant adopted a unique arrangement for processing high-silicon Kazakhstan ores. The Achinsk Alumina Combine, processing nepheline ore mined in Krasnoyarskiy Kray and Kemerovskaya Oblast, came on-stream. Large bauxite deposits were discovered in the Komi ASSR and Belgorodskaya Oblast. Mining of northern Onega bauxites commenced.

Commercial utilization of new raw materials -- nephelines, alunites, and high-silicon bauxites -- constituted a major achievement of Soviet science and the Soviet aluminum industry. This gave us confidence to look boldly to the future and ensured for quite some time a rapid rate of growth of this important subbranch of the metallurgical industry.

Movement on-stream in 1975 of the Tajik Aluminum Plant, equipped with electrolytic cells with calcined anodes and employing a current of 160,000-175,000 amps, constituted a new stage in the development of this industry. Consumption of electric power per ton of product at this plant is lower than the industry average, and the percentage yield of top-grade aluminum is also greater. It is worth noting that representatives of 58 different nationalities and ethnic groups of the Soviet Union are employed at this enterprise.

Rapid growth and development of the aluminum industry makes it possible more fully to meet this country's steadily growing requirements in lightweight metal. At the same time we devote considerable attention to improving the operating efficiency of our enterprises, adoption of no-waste and little-waste processes, reduction of material, energy and labor expenditures at all stages of production, improvement in quality of the metal, and prompt supply of various semimanufactures, alloys, and finished products to the customer.

The Soviet aluminum industry has gained international recognition. Eleven enterprises for the production of aluminum and alumina have been constructed abroad and brought on-stream with the direct participation of Soviet workers and engineers, and employing Soviet technology. More than 30 licenses for new technological innovations have been sold to 13 different countries, including the United States, Japan, and Canada.

Activities pertaining to improving technology and production efficiency have been raised to a new level since the 26th CPSU Congress. There is reason to be proud here as well. At the Pikalevo Alumina Association, at the Vokhov and Pavlodar aluminum plants, last year considerably less mineral raw materials, fuel and electric power were expended per ton of alumina than in preceding years. They have surpassed the design-specified basic technical and economic performance indices and have reduced production costs. This is a result of implementation of major technical measures: highly-efficient automated technological complexes and process control systems have been brought on-line. Extensive dissemination of advanced know-how has also had an effect.

The Krasnoyarsk Aluminum Plant, which in the past was among the poorer performers, has substantially improved its performance figures. It has appreciably increased product yield from the electrolytic cells and aluminum production per worker. The electrolysis workers led by USSR State Prize recipient A. Ryabov are achieving considerable success. Last year alone they saved approximately 2 million kilowatt hours of electric power and surpassed by 23 percent the labor productivity target. Incidentally, A. Ryabov's crew is one of the initiators of the all-union socialist competition to honor the 60th anniversary of the USSR in a worthy manner.

Presently our task is to make advanced know-how accessible to everybody in the shortest possible time. Here lies the key to further increasing metal production and more efficient utilization of the vast production and scientific-technical potential of industry. Attention is concentrated on executing designed combined technical development programs, which specify development and incorporation in the current five-year plan of new energy-conserving industrial processes, modernization of heat utilization arrangements, and furnishing enterprises with modern equipment. There will occur accelerated completion of new buildings with high-output, highly-mechanized electrolytic cells at the Tajik and Sayanskiy aluminum plants, as well as installation of an automatic alumina feed system, which will reduce labor expenditures everywhere and will improve product quality.

With strong support by the USSR Academy of Sciences and its institutes, preparations have begun for building a metallurgical complex for aluminum production at which there will be a substantial decrease in expenditure of energy resources, with aluminum production brought closer to its points of consumption, resulting in a substantial reduction in transportation costs.

Also in progress is work with numerous metals customers aimed at increasing the efficiency of metal utilization by more extensive combining of casting and rolling, an increase in the percentage share of non-remelted products, and adoption of little-waste manufacturing processes. Machine builders still

employ excessive allowances for machining products of nonferrous metals. The USSR Ministry of Nonferrous Metallurgy has examined, jointly with consumers, ways to achieve better utilization of nonferrous metals.

Studies by Soviet scientists have convincingly shown that priority growth of aluminum production is essential for accelerated development of the economy and for satisfying the growing requirements of a multisector economy. The aluminum production growth rate in developed capitalist countries in the last 30 years has been three to four times the growth rate of steel production. This should be considered by USSR Gosplan as well as those organizations which are called upon to foster the earliest possible movement on-stream of new facilities at our plants, as well as technical retooling of this industry.

In short, the tasks facing the aluminum industry today are important and difficult. We shall assuredly apply all our energy and resources toward their successful accomplishment. But the assistance of related organizations is also needed. The USSR Ministry of Power and Electrification, for example, should provide more stable electric power supply to plants, for even a brief interruption in supply of electric power leads to irreplaceable losses of aluminum and worsening of its quality. We also hope that the Ministry of Heavy and Transport Machine Building will improve the reliability of manufactured equipment and will speed up the development of equipment for automated servicing of industrial processes. We need machines equipped with all means of automation, which would enable us substantially to reduce labor expenditures. It is also essential to improve the evenness of flow of soda products to our plants, and at enterprises of the Ministry of Petroleum Refining and Petrochemical Industry to accelerate movement on-stream of new facilities for the production of high-quality petroleum coke.

Great hopes are being placed on enterprises presently under construction, especially the Sayan and Tajik aluminum plants, which are being provided with the most modern equipment and technology.

Today in the coal mines, at the furnaces and electrolytic cells, at all workplaces, the workers of aluminum industry enterprises, just as the entire Soviet people, are preparing worthy labor gifts in honor of the 60th anniversary of the USSR. They are successfully achieving fulfillment and overfulfillment of the state plan and socialist pledges for 1982. Thousands of tons of above-target metal have already been delivered to this country's economy.

3024
CSO: 8144/1414

UDC: 669.71'74'884

PHASE COMPOSITION OF Al-Mn-Li ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 82
(manuscript received 28 May 80) pp 207-210

TARASENKO, L. V., TURKINA, N. I. and MATVEYEVA, G. N., Moscow

[Abstract] A study is presented of the phase composition and structure of an alloy consisting of aluminum plus 1.3 to 1.5% Mn and 2.5 to 2.9% Li after casting, homogenization and also after hardening and aging of hot pressed strip, hot and cold rolled sheets. All of the semifinished products were hardened in water from 525°C, aged at 200°C, 6 hours. The alloys were found to form a nonequilibrium manganese intermetallide as well as Al-Mn and Al-Cr-Mn alloys. After hardening and aging, the alloy with 2.9% Li contains $MnAl_6$, Al_3Li and AlLi. Heat treatment in air forms a mixture of Li_2O_2 and $LiAlO_2$ on the surface of the cold rolled sheets, decreasing their strength in comparison to hot rolled sheets. After hardening and aging, hot pressed strips have greater strength due to the press effect than do sheets in which the phenomenon does not occur. Figures 2; references 6: all Russian.
[156-6508]

UDC: 620.22:678.5

INFLUENCE OF CORROSIVE MEDIUM ON FATIGUE IN METALS PROTECTED BY POLYMER COATINGS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 26, No 6, Jun 82 (manuscript received 30 Nov 81) pp 517-518

BELYY, V. A., academician, Belorussian Academy of Sciences, GOL'DADE, V. A., NEVEROV, A. S. and PINCHUK, L. S., Institute of Metal-Polymer System Mechanics, Belorussian Academy of Sciences

[Abstract] A study is made of the cyclical strength of type 08kp steel protected by inhibiting coatings based on polyethylene upon exposure to a corrosive environment. The experiments were performed on low-carbon structural wire specimens 3 mm in diameter and 100-150 mm in length which were coated with low pressure polyethylene after sanding and degreasing. The coatings contained mineral oil and a metal corrosion inhibitor. The specimens were exposed to a 0.2 n solution of sulfuric acid, then bend tested. It was found that the coated specimens had higher initial cyclical strength than uncoated specimens, and lost their strength much more slowly than uncoated specimens upon exposure to the corrosive medium.
[146-6508]

COMPOSITE MATERIALS

UDC: 539.4:629:678.067

INFLUENCE OF HYBRID COMPOSITE MATERIALS ON DYNAMIC CHARACTERISTICS OF HELICOPTER BLADES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 11 May 81) pp 475-479

PAK, Ye. G., STEKOL'NIKOV, V. N., GANYUSHKIN, Yu. P., IVANNIKOVA, R. V. and KESTEL'MAN, V. N.

[Abstract] The requirements for helicopter blade strength and durability are best met by composite materials. Replacement of the metal blades by glass-reinforced plastic blades in the Ki-18 helicopter has allowed the thrust of the main rotor to be increased by 4.58%, the static ceiling by 140% and the payload by 87.5%. However, the natural oscillating frequencies of GRP blades may be quite close to the operating frequencies, causing increased loading not only on the blades but on the structure of the entire helicopter. A study is made of several possible design methods of changing the natural oscillating frequencies of helicopter main rotor blades. Strengthening of the blades with high modulus carbon fibers allows a differential variation of rigidity characteristics, thus improving the dynamic characteristics of the lifting rotor. Hybrid composites are promising materials for the creation of main rotors with optimal dynamic characteristics while conserving the technical requirements for the lifting rotor system. Figures 1; references 7: 5 Russian, 2 Western.
[164-6508]

UDC: 539.4:678.067

MICROSCOPIC MECHANISMS OF DEFORMATION AND FRACTURE OF FIBER COMPOSITES

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 11 Jan 82) pp 410-416

VLADIMIROV, V. I., PERTSEV, N. A., PRIYEMSKIY, N. D. and ROMANOV, A. Ye., Institute of Physics and Technology imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] A study is made of the sequence of processes occurring upon loading of a composite material with a plastic matrix and plastically non-deformable fibers. The basic qualitatively different stages in plastic deformation of the material are distinguished and the factors leading to the transition from one stage to another are analyzed. The theory of dislocations and disclinations is used to calculate specific mechanisms of deformation and fracture of the composite. Fracture foci which develop in the composite result from the process of plastic deformation of the matrix through the stages of formation of a dislocation structure next to the fibers including Orowan loops and linear dislocations inhibited by the loops, creating deformation hardening, followed by generation of rotational or disclination modes of microplastic deformation relaxing the elastic fields of the previous dislocation structure, and finally development of disclination modes of macroscopic plastic deformation resulting in fracture or delamination of the fibers and thus failure of the entire material. Figures 6; references 16: 9 Russian, 7 Western.
[164-6508]

UDC: 539.3:678.067

NONLINEAR PHENOMENOLOGIC MODELS OF FIBER COMPOSITE MATERIAL DEFORMATION

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 11 Jan 82) pp 390-393

OBRAZTSOV, I. F. and VASIL'YEV, V. V., Institute of Aviation Technology imeni K. E. Tsiolkovskiy, Moscow

[Abstract] A discussion is presented of several phenomenologic models of fiber composites allowing the nonlinear effects which develop upon changing of fiber orientation or failure of the binder in the process of loading to be described. It is presumed that the material is formed of homogeneous orthotropic layers whose mechanical properties are experimentally determined. The equations derived can be used to determine the equilibrium forms of systems of flexible fibers. As an example, the equilibrium forms of a cylindrical pressure cylinder are analyzed. Figures 6; references 3: 2 Russian, 1 Western.
[164-6508]

UDC: 539.3:677

CARBON FIBER AS EXAMPLE OF SELF-REINFORCING COMPOSITE

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 3, May-Jun 82
(manuscript received 8 Jan 81) pp 387-389

BEZRUK, L. I. and KHOREVA, G. B., Institute of High Molecular Chemistry, Ukrainian Academy of Sciences, Kiev

[Abstract] One model of the internal structure of a single carbon fiber includes jacketing layers surrounding a core with radial location of morphologic formations including long cavities extended along the axis of the fiber. All of the models of the carbon fiber published to date indicate that each fiber is a complex structure similar to a composite material, with longitudinal structures reinforcing the overall fiber. The authors studied the structure of graphite fibers using high resolution techniques. Typical defects such as kink bands and folds were found to be more prevalent near the surface than near the axis of the carbon fibers. Even though the fibers are chemically homogeneous, they are ultrastructurally heterogeneous, representing self-reinforcing composites. Figures 3; references 7: 4 Russian, 3 Western.
[164-6508]

UDC: 669.893+669.71:539.415

RELATIONSHIP BETWEEN STRENGTH AND STRUCTURE OF PRESSED BOROALUMINUM DIVISION BOUNDARIES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82
(manuscript received 22 Apr 81) pp 80-84

SHORSHOROV, M. Kh., USTINOV, L. M., VERKHOVSKIY, L. A. and GUKASYAN, L. Ye., Moscow

[Abstract] Results are presented from a study of the relationship of the structure of the division boundary and longitudinal strength of pressed boroaluminum specimens. Special selected fibers with practically identical strength but widely differing Weibull strength distribution factors were used. These fibers were used as strengtheners in production of boroaluminum by vacuum pressing of sets of plasma specimens in an AD1 aluminum matrix at 520, 550 and 580°C. Increasing pressing temperature decreases the strength of the boroaluminum monotonically. The strength of the boroaluminum produced with one batch of fibers was significantly greater than with the other, primarily because over the critical length of the fiber the strength of the fibers in the first batch was significantly greater than in the second. This results from the greater scale effect of strength in the fibers of the second batch with lower value of Weibull coefficient than in the first batch. Figures 4; references 4: all Russian.
[155-6508]

UDC: 621.762

MAGNETIC ORIENTATION OF DISPERSED PARTICLES IN COMPOSITE MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 82
(manuscript received 23 Feb 81) pp 79-82

KARPINOS, D. M., YAGLO, G. I., APININSKAYA, L. M., YEFREMOVA, N. F. and MAKSIMENKO, Yu. A., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] The purpose of this study was to develop methods of testing the magnetic properties of individual particles or fibers covered with a ferromagnetic material, and also to determine the possibility of controlling these particles and fibers during the production of composites. It is assumed that it is sufficient to act on the particles or fibers with a magnetic field on the order of the coercive force to orient them in the direction of the field, or in stronger fields to have the possibility of controlling the process of creating the composite consisting of chains of particles and fibers. The observations performed in a microscope showed that not only ferromagnetic particles and fibers, but also dielectric particles and fibers coated with a thin layer of nickel could be oriented into chains by the application of a magnetic field. Chain formation depends on many factors such as particle and fiber shape, quality of ferromagnetic coating, viscosity of filler, concentration of particles and fibers in the filler, magnetic field strength and time of its application. Figures 5; references 4: 3 Russian, 1 Western.
[160-6508]

NEW 'CONDITIONAL TON' INDICATOR IN METALLURGICAL INDUSTRY

Moscow EKONOMICHESKAYA GAZETA in Russian No 19, May 82 p 8

[Article by V. Vavilov: "Slowly Hurrying...."]

[Text] "The present period is not indicative. It can be viewed only as an intermediate stage," stated I. A. Vashchenko, chief of the planning and economic administration of the USSR Ministry of Ferrous Metallurgy, at the conclusion of our conversation.

He was referring to the following. On 31 December 1981 Minister I. P. Kazanets signed an order, which began with the following words: "In order to improve the efficiency of employment of finished rolled products and steel pipe in the economy...." Further on the text contained specific points on changing seven metallurgical and nine pipe and tube plants over to planning and evaluation of production plan fulfillment taking into account product labor intensiveness conversion factors.

An important step in economic work in the ferrous metallurgical industry was formulated in this manner. This step involved implementation of the CPSU Central Committee and USSR Council of Ministers decree on improving the mechanism of economic management.

Trial and Error Method

The shortcomings of the existing "ton" indicator have long been known. The question of replacing this main physical indicator, employed in planning and distribution of metals production, with another, more accurate and objective indicator, has been debated on numerous occasions. Criticism of the "ton" is caused by the fact that supplier plants remain essentially without incentive to manufacture metal products of economical structural shapes and sizes. Frequently customers are forced to accept excessively heavy, large-section rolled stock. This results in unwarranted overconsumption of metal and diminishes the effectiveness of its utilization in the nation's economy.

The task consisted in planning and figuring production on the basis of a synthesizing indicator, which would reflect both the physical properties of rolled products and their consumer use.

Many suggestions were made on this score. Glancing at comparatively recent history, at the beginning of the 1970's many economists were of the opinion that the advantages of a linear unit -- meter in place of ton -- were incontestable. In 1972 they began planning manufacture and distributing steel pipe on the basis of meters. No preliminary experimental verification was performed. The experiment failed.

Practical experience revealed that this innovation failed to lead to any decrease in product metals input. On the contrary, due to an increase in the average weight of a linear meter of manufactured pipe, it was necessary to expend additionally each year 320,000 tons of steel. Why was this, one might ask. Customers received the opportunity to order and use thicker-walled pipe. And they did not fail to do so. In subsequent years USSR Gosplan and Gossnab returned to the former procedure of planning production and distribution of pipe on the basis of a synthesized indicator in tons.

"Conditional Ton"

"It was necessary to find an indicator which would make it possible to coordinate the production plan in a new way with the plan of delivery of metal products to the customers," I was told at the planning and economic administration of the USSR Ministry of Ferrous Metallurgy. "Such an indicator crystallized."

We should state that the ministry has clearly been left in the starting blocks as regards practical improvement of the economic mechanism in the industry. Essentially it is just beginning to take measures which should have been taken at least a year and a half or two years ago.

But first we shall explain just what a "conditional ton" is. Manufacture of finished rolled products is planned not simply in physical tons, but rather in tons taking into account differing labor input. It is determined with the aid of special conversion factors. We know that efficient rolled sectional shapes are 25-30 percent more labor-intensive than conventional sectional shapes. This naturally changes the per-hour output of rolling mills. In order to provide incentive to manufacture efficient rolled products, a ton of efficient-section product is equated on the basis of a conversion factor to, let us say, 1.3 tons of more conventional stock.

But does this not do detriment to the customer? No, we do not believe so. Suppliers will have economic incentive to manufacture primarily rolled products of which the nation's economy is in the greatest need. A condition is issuing of stocks and purchase orders not in physical but in conditional tons.

The metallurgical industry had amassed certain experience in this area in preceding years. At that time competition was initiated in the rolling shops for delivery of product manufactured in a so-called narrowed margin of allowances, according to theoretical weight.

We shall briefly explain just what this is. GOST permits rolling of sheet steel with a thickness deviation, let us say, of not more than 0.2 millimeter.

Rolling to "minus" achieves savings in metal without any detriment to its use properties. Last year more than 40 million tons of steel were rolled at minimum tolerances.

A number of questions, however, connected with turning out economical metal products remained unanswered. Now, with the appearance of the "conditional ton," the system of planning in the ferrous metallurgical industry is being considerably reorganized. Some calculations have been performed at USSR Gosplan. They indicate that with adoption of the new indicator, more efficient production and consumption of rolled products will generate an annual savings of approximately half a million tons.

The Ice Began to Break Up, But....

At ferrous metallurgical enterprises many managers voice approval of the new indicator.

"We are supporters of the proposed system and view it as a progressive development," I was told by S. N. Ignat'yev, director of the Donetsk Metallurgical Plant. "I was working as a shop superintendent up until recently and know from my own experience how difficult it was to force them to fill orders for economical but high labor-input sectional shapes.... Frequently there was no compensation for the additional expenditures. Now the situation is changing. I would like the reorganization to take place without a lot of noisy objections, obstacles and hindrances."

This opinion is shared by other enterprise officials whom I met.

Sixteen enterprises officially were converted over to the "conditional ton" indicator effective 1 January. In the first quarter it appeared in daily production reports in addition to the gross indicator "ton of production."

But the reorganization is far from completion. An appropriate "Provisional Statute on Procedure of Planning and Evaluating Finished Rolled Product and Pipe Production Plan Fulfillment" has been adopted. But regulations on calculating work-loading of rolling mills, production, figuring and evaluating plan fulfillment in conditional tons in a calculated product mix had not been ratified even by the end of April. And yet these regulations are a principal working document, uniform for all enterprises of this industry. Without it plans are without arms, as it were, forced to operate in large measure by groping and fumbling, haphazardly.

I shall not go into the reasons. The regulations were approved by USSR Gosplan, USSR Gossnab, and the USSR Ministry of Ferrous Metallurgy. Only the USSR Central Statistical Administration is holding things up. I should mention that for the time being "ton" of finished rolled product continues to be utilized in the reports of local statistical agencies.

At the present time there are also other difficulties within the industry itself. The plan for the current year was handled by the previous, traditional method. Calculation of rolling mill work loading was performed in physical tons, without determining the labor input of individual types of metal product.

Customers were also given stocks in conventional tons, without foreseeing the possibility of changing over to the conditional ton at the beginning of 1982.

The people at the Ministry of Ferrous Metallurgy are presently trying to force into the new system the old procedure of planning and distribution of metal products. Sharp corners are protruding here as well. I was told at the planning and economic administration that the overall annual target for production of finished rolled stock, pipe and tube in "tons" and "conditional tons" does not coincide, with the difference running into hundreds of thousands.

How can this problem be resolved? No final decision has been made. One thing is clear: the people at USSR Gosplan and USSR Gossnab should give immediate assistance to the Ministry of Ferrous Metallurgy in practical implementation of this important economic measure.

We can state it as follows: the channel has not yet been cleared. Submerged rocks are encountered on the way to the objective. The process of improving labor remuneration for rolling mill workers is not everywhere running smoothly.

There are thin-sheet and cold rolling mills on the equipment inventory at a number of plants. The reorganization has ignored them. As a result, while in other shops and on other mills production is planned and evaluated in conditional tons, on these mills planning continues to be in conventional tons. One can imagine how confusing accounting and record keeping becomes in this situation.

At the Ministry of Ferrous Metallurgy they cite the Novolipetskiy Metallurgical Plant as an example -- at that plant the changeover to the new indicator is proceeding more successfully than at other enterprises. They quote the following figures: in the first quarter the plant increased rolled product output by 3.5 percent in physical tons, and by 5.5 percent in conditional tons.

But I was told the following by the chief economist at the Novolipetskiy Metallurgical Plant, V. A. Breus: "At this plant the enterprise's entire economy continues to be tied to physical tons. The level of labor productivity is evaluated and labor force work incentives are provided on the basis of the 'ton' indicator. It is essential to complete the reorganization. The plant's economists are having quite a hard time of it. At present they are forced to maintain 'triple accounts': they must keep figures in physical tons, conditional tons, as well as calculation tons. The work load has unjustifiably increased, causing organization of economic work to suffer."

A similar statement was made by V. A. Kuvshinov, chief of the planning and economics department of the Magnitogorsk Combine, which is one of a large number of enterprises preparing to convert over to the new system of indices beginning in the second half of 1982.

This progressive process is proceeding, but there are more than enough various cases of lack of coordination and unresolved problems. Let us hope that ministry officials will draw lessons from this, will reach critical conclusions from the work that has already been done, and will improve it.

3024
CSO: 1842/133

UDC: 669:539.214

PORE FORMATION IN SUPERPLASTIC DEFORMATION OF MA8 MAGNESIUM ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 82 (manuscript received 15 Jun 81) pp 81-86

VALIYEV, R. Z., KAYBYSHEV, O. A. and SERGEYEV, V. I., Department of General Technology and Metal Science, Ufa Aviation Institute

[Abstract] MA8 Magnesium alloy (Mg+1.5% Mn+0.3% Ce) was studied, since the conditions under which it becomes superplastic are well known. Specimens were deformed by extension at 400°C at various rates from $3\cdot10^{-2}$ to $8\cdot10^{-5}$ s^{-1}. The specimens were ground and mechanically polished to at least 0.3 mm depth to study pore formation and distribution. Superplastic deformation was found to be accompanied by the formation of pores and their growth. The increase in porosity during deformation is described by the function $f = a\varepsilon^n$, with n increasing from 1.3 to 2.2 as initial deformation rate increases from $8\cdot10^{-5}$ to $8\cdot10^{-2}$ s^{-1}. The presence of pores has no significant influence on the deformation mechanism in the early and stable stages. Accumulation and growth of pores results in failure of the specimen, though fracture of the material between pores is most important in the formation of cracks. Figures 4; references 17: 6 Russian, 11 Western.
[162-6508]

SEEKING FULLER UTILIZATION OF MINERAL RAW MATERIALS

Moscow EKONOMICHESKAYA GAZETA in Russian No 18, Apr 82 p 9

[Article by A. Arbatov, laboratory chief, All-Union Scientific Research Institute of Systems Research of the USSR State Committee for Science and Technology and the Academy of Sciences: "Mineral-Raw Materials Base in Conditions of Intensification"]

[Text] The mining branches of industry account for a substantial share of capital spending, productive assets, and labor resources. Improvement in efficiency of mining and utilization of raw materials, economizing in raw materials, increase in the percentage share of secondary resources, and intensification of the aggregate of extractive industries developing the mineral-raw materials base constitute one of the principal directions aimed at intensification of societal production.

How do we define intensification of the mineral-raw materials base? First of all it is defined as maximum utilization both of the natural potential of deposits of commercial minerals and of all mining-extractive facilities. Also sought is a more efficient territorial combination of the various resources and the locations where they are consumed, making it possible to reduce transportation costs and optimally to form an environment for development of production and the daily activities of the population.

Comprehensive Processing

Considerable potential for improving the efficiency of production is connected with more complete processing of mineral raw materials. There exists virtually no ore body containing just one commercial mineral -- as a rule they contain an aggregate of substances which are diversified from the standpoint of their utilization.

The mineral-raw materials base, however, is distributed among branches for the most part in ore deposits of those constituents toward which they are focused as regards extraction and processing of raw materials and putting out initial product. It is unprofitable for enterprises to produce raw materials which do not fall within the product list of that branch. Therefore in working many commercial mineral deposits, dozens of highly valuable raw materials end up in spoilbanks or in beneficiation mill tailings, the content of which is utilized on the average at approximately 3 percent.

Comprehensive utilization of mined raw materials would make it possible to obtain at presently existing mining industry enterprises 25-30 percent more production than is presently the case. One must also consider the fact that additional expenditures would not be required for geological surveying and exploration, construction of mining facilities and infrastructure elements, establishment and maintenance of spoilbanks, restoration of mined-over land, plus other environmental protection measures. As a result, additional output would cost the nation's economy from one fourth to one half as much. Of course this would require a certain increase in one-time capital spending for comprehensive processing of raw material. But these expenditures would be recouped considerably more rapidly than when working new ore bodies. Considerable positive ecological effect is achieved, since there is a reduction in the total volume of spoilbanks and beneficiation mill tailings, and the scale of mining activities is reduced.

In spite of the obvious benefit to the economy, the problem of comprehensive utilization of commercial minerals is being resolved with far less than the degree of decisiveness and on far less of a scale than it deserves. There are a number of reasons for this, particularly the fact that a large number of ministries and agencies are involved. Following are the principal ways to solve this problem. First of all, a sharp increase in the influence of regional management agencies on the process of exploiting deposits of commercial minerals. Secondly, change in the branch structure of industry, proceeding from unity of the entire aggregate of desirable minerals in a deposit and the technology employed in mining the various minerals. And of course any reorganization should be based on a well-substantiated economic appraisal, making it possible realistically to determine the economic effect of measures being implemented.

Economic Appraisal

A long-range strategy of development of the mineral-raw materials base is grounded on an economic appraisal of mineral resources. Determination of the economic value of mineral deposits helps choose trends in their utilization whereby maximum effectiveness of societal production is assured. Many questions in this area were settled in preparing the "Provisional Standard Method of Economic Appraisal of Mineral Deposits," as well as in a number of studies.

This method makes it possible to consider the overwhelming majority of factors which affect a monetary appraisal of mineral deposits. With improvement of methods of analysis and economic appraisal, it will be possible to incorporate more and more new data into the calculation formula, refining and detailing the overall economic significance of an ore body. Future improvement of this method consists precisely in determination and adequate expression of the various factors which affect the value of a mineral deposit. It is advisable to speed up investigations being conducted in this area.

In particular, of great significance for comprehensiveness of utilization of the mined mineral material and determination of reasonable limits of utilization of secondary constituents is figuring of the value of those

secondary constituents the content of which is below that which is currently profitable. One should determine thereby the cost of exploration and development of an equal quantity of mineral reserves in those ore bodies where the mineral is contained in concentrations currently being mined, the cost of raw minerals in the world market, as well as additional costs involved in recovering this constituent.

Intensification of the mineral-raw materials base presupposes utilization of natural combinations of ore deposits, on the basis of which combined facilities for producing various raw minerals can be established. This results in a considerable reduction of transportation costs, and a single production and social infrastructure is establshed for an entire aggregate of mineral deposits. In a number of operations it is possible to combine the processing of ores from different deposits. This will make it possible to amalgamate and automate production, thus achieving savings in labor resources. Negative ecological consequences are also diminished.

For example, if there is a phosphorite deposit alongside a sulfur-containing deposit, the sulfur becomes a valuable raw material for the production of sulfuric acid, large quantities of which are needed in the manufacture of phosphate fertilizers. Deposits of sulfide ores of nonferrous metals in Central and Eastern Kazakhstan, which contain large quantities of sulfur, and phosphate ores in the Karatau basin mutually supplement one another in this manner. Low-grade chromite and manganese ores, also being mined in Kazakhstan, serve as another example. Kazakh scientists have developed a process of obtaining, from these ores and Ekibastuz high-ash coal, mined in the vicinity, coal which is rich in aluminum and silicon, complex aluminum-chromium-silicon and aluminum-manganese-silicon alloys, which can be utilized for deoxidizing and alloying steel. The economic significance even of comparatively small deposits of alloying metals or coking coals in the vicinity of existing or planned enterprises also increases.

Consideration of Regional Features

Rational utilization of national resources calls for a combined approach to a region's entire natural resources. This means taking into consideration all the natural resources of a mining area from the standpoint of the possibilities of their utilization in exploiting mineral deposits and estimating the damage which can be caused as a result of mineral mining and processing activities. The mining industry is a large-scale consumer of such natural resources as water, land, and timber. Therefore study of the possibilities of the entire natural-resource complex of an exploitation area and its efficient utilization is essential for determining the development prospects of basic production and environmental protection measures. In addition, in many instances an area's natural resources can serve as a supplementary source of supply.

Large-scale programs of development and exploitation of the mineral resources of individual regions should be closely coordinated with their social development plan. Such programs are drawn up in the context of the overall socioeconomic development of regions, influenced by their character and the specific features of available raw materials.

The character of mineral raw materials and the amount of reserves also affect development strategy. Large-tonnage raw materials (coal, iron ore) require a massive transportation network and the building of primary processing facilities. Substantial labor resources are needed for exploitation of these minerals, in contrast to such raw materials as oil and gas. Some nonferrous and precious metals, mined in comparatively small quantities, can in many cases be transported out of the area of origin without substantial primary processing, especially if there are large river arteries and a well-developed railway network available.

Volume of reserves determines the exploitation and development timetable. The largest and most unique ore deposits require considerable time for development and exploitation, while large quantities of extracted ore make it advisable to build large processing facilities. Such a large industrial center, as local reserves become exhausted, can also operate on hauled-in raw materials. Comparatively small reserves can be worked with easily-disassembled equipment, with an appropriate infrastructure. The watch-expedition method can be employed in mineral exploitation activities in primitive, undeveloped areas.

When elaborating a long-term mineral raw materials base development strategy under conditions of limited funds and resources, one must also proceed from the priority ranking of those types of raw materials which are basic for the principal advanced technologies of the future. Growth in demand for certain materials is of an explosive nature. Therefore it is necessary to prepare in advance a mineral-raw materials base oriented toward the principal trends of scientific and technological advance.

It would appear at the present time that the most important raw materials are those employed in electronics, microprocessors, in the manufacture of high-quality alloys and materials with predetermined changing properties. Of course there may arise totally new industries, requiring new types of raw materials, or a sharp increase in the production of materials currently in production. The role of scientific-technical and economic forecasting increases in connection with this. An important element in its development is drafting of a Comprehensive Program of scientific and technological progress in the USSR up to the year 2005.

Reserve potential for intensification of the mineral-raw materials base involves deepening international division of labor. We have amassed considerable experience in this area, particularly in conditions of socialist economic integration within the framework of CEMA. Execution of long-term specific-purpose programs of cooperation has shown the extensive possibilities of cooperative activities in providing the economy with raw materials. Our foreign-trade policy pertaining to the importation of mineral raw materials requires further improvement on the basis of determination of priority types of raw materials from the standpoint of achieving savings in domestic capital investment and current expenditures. Of course the importation of raw materials requires considerable funds. In order to obtain such funds it is necessary to develop profitable export branches, including certain raw materials, giving preference to those which produce raw materials at the lowest cost and which enjoy a favorable market. Of great significance in intensification of

the mineral-raw materials base is economic, scientific and technical cooperation with developing countries in development and exploitation of their mineral-raw materials base, which will ensure the supply of raw materials as compensation for rendered assistance. This form of cooperation is most fruitful in close coordination with the other CEMA member nations.

The great diversity of ways to achieve intensification of our country's mineral-raw materials base by no means assumes that implementation of one or two of these can radically affect production efficiency. Only purposeful efforts in all areas can create conditions for accomplishing the task of intensification of the mineral-raw materials sector of the economy.

3024
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MINISTER URGES IMPROVEMENTS IN NONFERROUS METALLURGY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Jul 82 p 2

[Article by P. Lomako, USSR minister of nonferrous metallurgy: "In a Combined Manner, With Good Management"]

[Text] I am looking through the labor reports of leading workforces, received by the ministry on the eve of Metallurgical Worker Day. Here is a report from the Bashkir Copper and Sulfur Association: "With pledges to boost by 0.2 percent recovery of copper and zinc into concentrates, this indicator increased by 1.5 percent." This good bit of news was sent to the ministry by A. Suvorova, head of one of the 18 leading brigades in the nonferrous metallurgical industry which appealed to the workers of this industry to promote socialist competition for ahead-of-schedule accomplishment of this year's targets and for a worthy greeting to the 60th anniversary of establishment of the USSR.

Comrade L. I. Brezhnev emphasized in the Central Committee Accountability Report to the 26th CPSU Congress that "the successes of the entire national economy will depend in large measure on improving the efficiency of the extractive industry. The way to achieve this is acceleration of scientific and technological advance, combined, thorough processing of minerals, and more extensive utilization of secondary resources."

This statement applies in full measure to each and every geologist and miner, beneficiation mill worker and metallurgical worker, as well as every administrator in our industry. We have plenty of opportunity to apply our energy and knowledge. Old nonferrous metallurgical centers in the Urals and the Transcaucasus are being further developed, and large enterprises have been built in Eastern Siberia and the Far East, in the Ukraine and Kazakhstan, Kirghizia, Tajikistan, Uzbekistan, Georgia, Azerbaijan, Bashkiria, and other parts of the country.

In recent years there has been a substantial increase in output volumes of the principal products -- aluminum, copper, nickel, titanium, lead, tungsten, rare and other metals. In addition to this, more and more complete recovery of valuable constituents from mineral raw materials is being achieved: the nonferrous metallurgical industry is today producing almost three fourths of the elements known from Mendeleyev's periodic table.

Our enterprises have successfully brought into production such items that are needed by the nation's economy as mineral fertilizers, sulfuric acid, copper sulfate, as well as cement and soda products. Increased production of these items has been promoted to a considerable degree by the adoption at many plants and combines of no-waste and low-waste manufacturing processes and extensive utilization of waste gases generated during smelting and roasting processes. Suffice it to say that two thirds of the 5 million tons of sulfuric acid produced each year by the nonferrous metallurgical industry is obtained from such gases, and every ton of sulfuric acid serves as the basis for producing four tons of mineral fertilizers, expanded production of which was discussed at the May (1982) CPSU Central Committee Plenum.

The general direction of development of the nonferrous metallurgical industry is strengthening of the industry's raw materials base and its priority growth, more comprehensive and fuller utilization of raw materials, adoption of efficient industrial processes and high unit-capacity equipment in mining and processing ores and concentrates.

Considerable importance in the branch comprehensive program of technological advance is attached to measures to reduce ore losses in mining, that is, at the beginning of the production chain. Employment of a system of mining ore bodies where mined-out space is filled with hard-setting fill has proven highly effective. Extensive adoption of this system has made it possible to improve the operations of the Noril'sk Mining and Metallurgical Combine, the Gay Mining and Beneficiation Combine, the Leninogorsk Complex Ore Combine, the Zyryanovsk Lead Combine, plus others. Work based on their experience is also in progress at the Orlovskoye, Tekeli, and Tishinskoye ore deposits in Kazakhstan.

The Main Directions of development of the national economy in the 11th Five-Year Plan and beyond assign ferrous metallurgical industry workers the task of "improving the technology of mining and processing ores and concentrates, increasing the comprehensiveness and completeness of utilization of mineral raw materials...." The USSR Ministry of Nonferrous Metallurgy bases its decision on basic research conducted by branch science and institutes of the USSR Academy of Sciences, Ukrainian SSR, and Kazakh SSR.

A comprehensive specific program of scientific research and experimental activities up to 1990 has been drawn up. In particular, it specifies adoption of an ore quality control system at the juncture between mine and beneficiation mill. The purpose is to improve the quality of the ore received for beneficiation, in order to compensate for its progressively lower grade.

New industrial processes should play an important role: flotation and froth separation, employing selectively acting reagents, wet magnetic separation in a high-voltage field, gravitation concentration of slimes, and radiometric separation. Plans call for more intensive adoption of combination arrangements, which will make it possible to recover more metals from low-grade concentrates, including secondary-constitutent metals.

The enterprises of this industry are increasingly more frequently employing modern mine transport equipment, particularly self-propelled equipment, which makes it possible to increase the labor productivity of workers on the mining face by 50 to 100 percent and more. The Achisay Complex Ore Combine, the Solnechnyy Mining and Beneficiation Combine, the Dzhezkazgan and Noril'sk Mining and Metallurgical combines have virtually fully converted to this equipment. But such equipment is presently in short supply.

Ore is transported primarily by dump trucks. Here too complaints must be leveled at the Ministry of Automotive Industry: its enterprises are slow about putting new innovations into production and raising the technical level of trucks. We are not pleased with the BelAZ 40-ton truck due to its limited load capacity; at the present time our mining operation has few 120-ton trucks, and the poorly-designed 75-ton dump truck is down for repairs more than in operation. The Ministry of Heavy and Transport Machine Building is delaying the manufacture of underground self-propelled equipment of the requisite power rating.

Considerable reserve potential is to be found in beneficiation and metallurgical production. Much has been done here, but much still remains to be done. Concentration mills are now equipped with large, high-output mills, flotation units, and sophisticated gravity separation equipment for recovering metals from slimes. A growing volume of ore is being processed by the self-comminution method, concentration in heavy suspensions, with the aid of luminescent and froth separation. Soon we shall have laser, electron-ion and other highly efficient technologies which will make it possible substantially to improve the level of recovery of valuable constituents from ores. New industrial processes, high-output equipment and high-precision automation systems are being adopted in metallurgical shops. Employment of oxygen is producing considerable savings.

Aluminum industry workers have also made strides in efficient utilization of raw materials. At the Bratsk, Krasnoyarsk, Novokuznetsk, Tajik, and several other aluminum plants, major projects are under way to renovate equipment and adopt efficient, resource-economizing processes.

Having adopted no-waste combined nepheline processing arrangements, we are obtaining alumina, soda, potash, and belite slime, which is subsequently processed into portland cement. Last year, for example, the Volkhov Aluminum Plant, the Pikalevo Alumina Association in Leningradskaya Oblast, and the Achinsk Alumina Combine produced several million tons of cement and hundreds of thousands of tons of soda products from the combined processing of nephelines.

The Ust'-Kamenogorsk Lead and Zinc Combine and the Chelyabinsk Electrolytic Zinc Plant are successfully incorporating no-waste technology. Recently we offered warm congratulations to the Chelyabinsk people: installing a more efficient process in their sulfuric acid shop, setting up additional wastewater treatment, and setting up for processing wastewater treatment facility sludges, they have completed the changeover to no-waste production.

In recent years more and more additional sources of metallurgical raw materials -- low-grade and complex ores, slags and sludges have been tapped. Their efficient utilization is an urgent task of the day. This important business, however, is not advancing as vigorously as one would wish.

At the present time the principal raw material resources of this industry are concentrated in this country's Far North and Northeast. Many deposits of valuable nonferrous metals are situated in the permafrost zone. Exploitation of these rich resources requires special Arctic models of equipment, manufactured of cold-resistant grades of steels and alloys, with insulated cabs. The enterprises of the machine building ministries, however, are very slow about setting up for series production of this equipment, limiting themselves to experimental models.

Successful accomplishment of the tasks assigned to this industry is closely linked with fuller utilization of secondary resources -- scrap and nonferrous metals waste materials. There was held a few days ago a conference of representatives of party, soviet and economic agencies, called together by the CPSU Central Committee, at which the state of affairs regarding procurement, shipment and processing of these raw materials was analyzed, and at which directions and practical measures to raise the level of these efforts were specified. Implementation of the conference recommendations will ensure considerable savings to the nation's economy.

Socialist competition to honor in a worthy manner the 60th anniversary of establishment of the USSR, ahead-of-schedule meeting of the targets and pledges of this year and the five-year plan as a whole is in full swing at nonferrous metallurgical enterprises. The workers of this industry are filled with resolve to make a substantial contribution toward implementation of the historic decisions of the 26th CPSU Congress and strengthening of the economic potential of our homeland.

3024
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POTENTIAL FOR ECONOMIC GROWTH IN NONFERROUS METALLURGY

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 4, Apr 82
pp 3-8

[Article by K. Losev, first secretary of the Dzhezkazgan Obkom, Communist Party of Kazakhstan: "The Potential for Economic Growth"]

[Text] The 26th CPSU Congress and the November (1981) Plenum of the CC CPSU, which appeared, according to the descriptive expression of L. I. Brezhnev, as the straightforward and direct continuation of the work of the congress, supplied the communists and the entire Soviet nation with a clear program of actions on the further economic and social development of the country.

In resolutions of the congress and plenum, it is underlined that in the contemporary stage of communist construction, final results of the activity of the national economy depend mainly on an increased level of intensification of production and on a more complete and efficient use of all available reserves and resources.

Without exaggeration we can say that further reinforcement of the economic potential of our oblast depends to a considerable degree on increasing the efficiency and quality of work of the Dzhezkazgan and Balkhash mining-metallurgical and Zhayrem and Akchatau mining-concentration combines. This will impose a serious responsibility on collectives of the plants and their party organizations to create a strong nonferrous metallurgy raw-materials base and to provide for intensified production in combination with the highly complex use of ore raw materials and the economic consumption of all material and energy resources and with every kind of an increase in the production of nonferrous and rare metals.

By examining the route passed, we can note with satisfaction that much has been done in this direction. During the 10th Five-Year Plan, for example, the oblast's industrial production exceeded the plan by 39 million rubles, 29 million rubles of which was accounted for by nonferrous metallurgy plants. Basic industrial capital of hundreds of millions of rubles was introduced.

An analysis of economic activity for 1981 showed that the oblast's nonferrous metallurgy workers discharged their socialist obligations with honor, producing more than five million rubles above their assignment. The plans for

mining copper and lead-zinc ores and the production of refined copper were surpassed. Production volume of other high-grade metals and components was increased. One-third of the total volume of industrial production of four combines now receives the State Mark of Quality.

Questions of improved leadership at branch plants and the use of reserves to increase production efficiency have become the subject of studies at plenums of the obkom of the Party, bureau and secretariat. Important problems of the development of nonferrous metallurgy are being discussed at city and rayon, party and economic meetings, scientific-practical conferences and seminars. The militancy of the primary Party organizations, mines, pits, plants, and factories has been increased.

In his address to the November (1981) Plenum of the CC CPSU, Leonid Il'ich Brezhnev emphasized that is will be necessary to develop and implement plans better, and to better organize production and produce more. These instructions have guided the Party organizations and labor collectives in the development of plans and socialist obligations for the second year of the five-year plan.

Ambitious goals are being set for the expansion of the raw-materials base, the reconstruction and opening up of industrial plants, the use of equipment, and the lowering of losses of mineral resources during mining and processing. Suffice it to say that the oblast's output of refined copper for the five-year plan should increase by 15.9%. To achieve this goal, a reliable base has already been established. This is being expressed, first of all, in the economic use of everything we have available and in the more complete uncovering and introduction of internal production reserves.

Let us consider the largest nonferrous metallurgy plant: the Dzhezkazgan mining-metallurgical combine. Intensification of production here will result from a growth in the mining of ore by using modern powerdriven equipment. These [Dzhezkazgan] complexes will account for up to 81% of all ores extracted in underground operations. The labor productivity of the miners exceeds the average branch index by a factor of 2.5.

One way to increase efficiency is to intensify the development of movement of a thousand or more tons of ore per day using powerdriven equipment.

In giving paramount importance to the growth in labor productivity at mining enterprises, the Party obkom examined in particular the leadership of the "tysyachnik" brigades [brigades which mine a thousand tons of ore per day]. The partkoms [Party committees] of the mines and leadership of the combine already have done a great deal for better organization of the "tysyachnik" competition. The Party presence in collectives of the brigades has been strengthened, labor organization and discipline have been raised, the miners have changed their attitude toward their equipment, professional training of the working personnel has been increased, and personnel fluctuations have been reduced sharply. Now 12 brigades work at a mining level of 1000 tons or more of ore per day.

In the current five-year plan, at mines of the combine, it is planned to double the volume of filling with waste rock using hardening mixtures and to achieve a filling capacity of the equipment of up to 1600 cubic meters per year. This will make it possible to reduce considerably losses of mineral resources in the earth.

The importance of solving this problem is obvious, first of all, because at the deposit being developed there occurs a regular process of lowering the content in the ore of the base metal, and the mining-geological conditions are complicated. It is possible to overcome the shortage in copper-containing raw materials by increasing the mining of ore according to the technology outlined above, and also by developing shallow sections (less than 3.5 meters) of the ore body.

Here it is necessary to make a small clarification. During the many years' development of the unique Dzhezkazgan copper-lead ore deposit, extraction has been conducted in massifs with a large stratum of seams; the so-called thin seams have remained untouched. It is still not possible to extract these raw materials, since the available mining equipment is not "tailored" to the overall dimensions of the seam. To do this, small-sized equipment is necessary. Unfortunately, production of such equipment has not started in the republic and country. A positive solution to these pressing problems would result in an enormous advantage - the lowering of losses of mineral resources in mining by 15%-20%.

The active mining enterprises of the oblast have not been completely provided with reliable Soviet powerdriven machines for underground operations. Many types must be acquired abroad. The problem of the series production of state-of-the-art powerdriven equipment is being solved at a very slow pace at the plants of our country.

And there is more. The diversity of types of equipment for drilling, loading, and auxiliary operations creates difficulties in the organization of production, complicates the training of qualified personnel, and lowers labor productivity. Thus, facing the institutes and enterprises of USSR Mintyazhmash [Ministry of Heavy Machinery Manufacture] is the pressing problem of creating and setting up production in sufficient quantity of reliable, highly productive machines for underground operations, including small-sized powerdriven units for the development of shallow deposits. This will help in solving one of today's most important problems - providing the processing enterprises more completely with high-quality raw materials.

In the present five-year plan, the combine is faced with putting into the service of the active enterprises a number of industrial installations - two phases of mine No. 67, the first phases of the Annenskiy mine and concentration plant and a number of other objects. A capital investment of 380 million rubles was allocated for these purposes.

An urgent problem is to ensure the timely construction of important industrial objects and in the established time periods adopt the planned capacities.

Enormous reserves have been allocated to increase the efficiency of production.

"The intensification of economics and increase in its efficiency," stated Comrade L. I. Brezhnev at the 26th CPSU Congress, "if we transfer this formula into the language of practical matters, consists, first of all, so that results of the production would grow more rapidly than the expenditures for it, in order that by involving fewer resources in the production, it would be possible to achieve much."

This is why both the oblast and city Party committees have made it a rule to pay the greatest attention to the development of production capacities. Thus the obkom bureau discussed questions of the acceleration of development of newly introduced objects of the South Dzhezkazgan mine and Zhayrem mining-concentration combine.

It is in this connection that we would like to give attention to the operation of the other large copper giant of the oblast - the Balkhash mining and metallurgical combine. In recent years it has been provided in irregular fashion with copper-bearing raw materials, which has led to underutilized production capacities and, as a consequence, to lowered volumes of commodity production. This, in turn, has had a negative effect on labor productivity, profitability of production and use of industrial capital. In 1981 the capital productivity here dropped by 4.8% in comparison with the preceding year. This was not by accident: utilization rate for plants for processing molybdenum ores, for example, was 65%, for smelting crude copper, 80%, and for producing refined copper, 77%.

All of this leads to systematic disruptions of planned production deliveries and to errors in the planning and control of production. The process of the reliable delivery of raw materials to the combine by other enterprises has not yet been clearly organized. In just the last year alone, for example, the Balkhashites were undershipped 1.5 thousand tons of crude copper from the Irtyshsk polymetallic combine, more than 700 tons of metal in imported copper concentrate, etc.

However, there are deficiencies in the activity of the combine itself. The mining enterprises operate irregularly, and the fulfillment of plans for preparatory operations is disrupted. It is not by chance, therefore, that the plan in 1981 on the stripping of deposits of ores was fulfilled only by 94%. Mining equipment, especially drills, is still being underutilized.

It is necessary as rapidly as possible to eliminate these deficiencies and organize an interruption-free operation of the mines.

Another important problem bothering the Balkhashites is the acceleration of the technical re-equipping of metallurgical and milling production. It appears especially acute now when the quantitative and qualitative makeup of the extractable components of the processable raw materials is being constantly lowered, and the equipment of the copper smelting plant, put

into operation as long ago as 1938, and of the milling production, in 1941, is technically inadequate.

The USSR Ministry of Nonferrous Metallurgy provided for the construction at Balkhash of an experimental-industrial complex for copper smelting in a "liquid vat" at a cost of more than 22 million rubles. Thus a fundamentally new metallurgical production will be created which will provide high productivity, increase the degree of complexity of the use of raw materials, make it possible to achieve considerable savings of fuel and decrease the environmental polution. It is necessary that the intentions of the staff of the branch be accomplished rapidly.

The Balkhash mining and metallurgical combine is the one enterprise in the oblast which produces nonferrous rolled products. At the same time, not all the problems connected with this production, in our opinion, are being solved in a positive way. Thus the smooth operation of the plant in the treatment of nonferrous metals and the complete use of the machinery are possible only when the plant is uniformly supplied with orders from Soyuzglavtsvetmet [Main Administration for Deliveries of Nonferrous Metals]. However, the glavk [central board] systematically allows an unwarranted disproportion, which consists in the fact that the production machinery of wire stock is annually underloaded with orders by 500-600 tons, whereas concerning the production of flat rolled stock they are overloaded. The youngest plant in the oblast, the Zhayrem mining-concentration combine, has large reserves available for increasing the efficiency of production. The 26th CPSU Congress posed a specific problem before the collective: "...to increase the mining of ore at the Zhayrem polymetallic deposit in every possible way." The Zhayremites responded to the challenge with shock labor. On 11 December 1981, they reported on the fulfillment of the yearly plan of the mining and shipment of ore 20 days earlier than the period set.

In the 11th Five-Year Plan the collective must increase its ore-mining capacity by a factor of 1.5. Users will receiver more than they did in the 10th Five-Year Plan: 45% more lead and 1.4 times more zinc. The production capacities of the combine are supplemented by the "Ushkatyn-III" mine, and by the experimental and main concentration mills.

The second phase of the enterprise is scheduled to reach planned capacity in 1988.

The tasks are demanding and complex but entirely fulfillable. For operational leadership and coordination of the work of the Party organizations, a unified partkom [Party committee] is being created in Zhayrem; it will include all Party organizations of the Zhayrem industrial region, including a geologic prospecting expedition and the recently organized "Zhayremtyazhstroy" construction-installation trust. The Dzhezkazgan gorkom [city committee] of the Party organized an out-of-town staff, which sees to the construction of main objects of the Zhayrem site. The Komsomol Central Committee announced the construction of the mining-concentration combine by the All-Union Shock Komsomol Construction.

At the same time, there are inadequacies. For example, the combine's equipment use indices are lower than the average branch indices. The reason, first of all, is that the enterprise is not completely staffed with personnel of the main professions, and the working personnel do not have high enough qualifications. This is the result, of course, of a weak organization of labor. It is not by accident that the collective has permitted a great lag in the mining-fundamental works. Measures are now being taken to increase the productivity of the mining transport equipment, which would help in fufilling the main task of increasing the mining of ore in the current five-year plan and of achieving high economic indices.

As before, the problem of water drawdown in the open pits remains acute. Ground waters appeared at the very beginning of the mining operations. The deeper the mining operation, the greater the influx. Another problem--the freezing of ore--has not yet been solved, and this leads to great difficulties in unloading it from cars in the winter. These and other important questions have already been covered in pages of the journal NARODNOYE KHOZYAYSTVO KAZAKHSTANA [NATIONAL ECONOMY OF KAZAKHSTAN] in the article "Horizons of Zhayrem." The thing that must be done now is to take pracitcal specific measures.

The introduction of highly productive mining and transport equipment--eight-cube excavator machines, 40- and 75-ton dump trucks, and the industrial development of powerful pumps of the "Pleyger" firm for the drainage of open pits--should greatly benefit the combine. Preparations are being made for the application of cyclic-continuous flow-line technology. It also will increase the efficiency with which the deposit can be worked out.

Recently, the collective of the Akchatau mining-concentration combine has begun to operate more successfully. Results of its economic activity in 1981 indicate much work done by the miners and concentrators in further increasing production, introducing mechanization and automation of industrial processes, and improving the quality of production. The combine significantly overfulfilled the industrial production plan, ensured its growth to the 1980 level and exceeded by 3% the assignment with respect to growth labor productivity. In open-pit mining operations it grew by 5.6% and in underground works, by 7.8%.

Quality indices have been improved: production of tungsten concentrate of higher quality has increased by 37% in comparison with 1975. In the Southeastern mine the production of molybdenum concentrate with a high metal content has started. Annual savings have amounted to 139,000 rubles.

In the present five-year plan the collective of the combine expects to assimilate the production capacities put into practice in the mining and processing of ore at the Dzhambul mine. New objects will be introduced at the Akzhal mine.

But this will not exhaust the reserves: in underground operations plans are under way to introduce, using the example of the Dzhezkazgan miners,

granulated explosives and to mechanize the blasting charges. Still to be improved are the process of enrichment of the ores in heavy suspensions, mechanization and automation of the laborious operations, and assimilation of the use of new reagents.

One of the most important factors in the strengthening labor discipline and creating stable collectives should be the brigade form of organization and payment of labor. Now 51.8% of industrial-production personnel are covered in this way. By the end of the five-year plan this level should be brought up to 70%. The economists and Party organizations will have to work on this.

Further, as is known, the mineral raw materials mined in our oblast contain many valuable components. By using the achievements of science and technology, and organizing waste-free production, it will be possible to achieve greater production at less cost. This is the goal aimed for by workers of the branch in the well-known decree of the CC CPSU, "On the work of Party organizations of the Ust'-Kamenogorsk lead-zinc and Balkhash mining and metallurgical combine on the mobilization of collectives for the achievement of high indices in the complex use of ore raw material." Today at Balkhash and Dzhezkazgan, respectively, 32% and 33% of the industrial production consist, incidentally, of extractable production, and in the final conversion, metallurgical production, the coefficient of complexity of the use of the raw materials reaches 93% at the Dzhezkazgan combine and 94% at the Balkhash combine.

But here the reserves have still not been exhausted. The raw materials of the old pit dumps are increasingly being drawn into the Conrad ore being processed by the concentration plant of the Balkhash mining-metallurgical combine. Since the second half of 1981, oxidized sayakskaya ore has been processed, which considerably increases the completeness of the use of the mineral resources. Potential raw materials are also the pit-dump "tails" of molybdenum production, which contain bismuth, tungsten and rare metals. The development of an acceptable technology for the extraction of these valuable components is of paramount importance to scientists and specialists.

In metallurgical production extensive possibilities exist for increasing recoverable metals through intensification of the reverberatory melt, improvement of dust-catching apparatus, development of a method for processing copper concentrates in converters, etc.

Concentrators at the Dzhezkazgan mining and metallurgical combine are solving a complex problem: under conditions of lowered metal content in the ores being processed and worsened material composition, they are ensuring the retention of the achieved level of the extraction of copper and bringing the extraction of lead up to the planned volume.

In the metallurgical production of the combine, through the efficient use of raw materials, increased quality and completeness of recovery of metals, and technical re-equipping of the basic conversions, the present five-year plan provides for increased output of the main production by 2.7%, and sulfuric acid by 7.5%, and for bringing sulfur extraction up to the planned

level. The output of refined copper with the state mark of quality is to account for 75% of total production. By-product production is to be brought up to 35% of the total volume of commodity production.

Currently, 16 of the 19 useful components contained in the parent raw material are being extracted by our four combines.

Without a doubt, the main activity of the plants and, through the whole branch, the fulfillment by them of production plans, are directly related to the state of affairs in capital construction. It must be said, however, that here the situation is far from favorable. Here are examples.

In the past year 12.5 million rubles were allocated to the Balkhash mining-metallurgical combine by the Kazakh SSR Mintsvetmet, and Mintyazhstroy [Ministry of Heavy Construction] for construction and installation work, which included 10.5 million rubles for industrial construction. In fact, however, only 6 and 3.5 million rubles, respectively, have been forthcoming. Earmarked for construction this year for the combine are 6.2 and 4.9 million rubles, respectively, which is less than one-half the specified volumes.

Such rates would jeopardize fulfillment of important construction plans of the 11th Five-Year Plan. With such a position, it would appear necessary to bring the plan of industrial production into conformity with construction realities or to implement those projects which would guarantee that the most important objects could be realized within the given periods.

The CC of the Communist Party of Kazakhstan and the Council of Ministers of the republic earmarked 630 million rubles for construction and installation projects at nonferrous metallurgy plants of our oblast in the 11th Five-Year Plan. By years, the assignment was to be as follows: 116 million rubles in 1981, 124 million in 1982, 125 million in 1983, 137 million in 1984, and 128 million in 1985. Acutally, during 1981 the construction-installation projects were accomplished with 83 million rubles, which is only 71% of the projected amount.

The 1981 plan was 100% fulfilled by the organizations of Mintyazhstroy and Minmontazhspetsstroy [Ministry of Installation and Special Construction]. However, the assignment established by the CC of the CP of Kazakhstan and the Kazakh SSR Council of Ministers remained underfulfilled by 28 million rubles, or by almost 36%. This position exemplifies the discrepancies between projected volumes for construction-installation works and annual plans of capital construction with established assignments.

It is fitting, then, that we discuss the course of construction of industrial plants and objects of the Dzhezkazgan mining-metallurgical combine, which provides the Balkhash mining-metallurgical combine with raw materials. In conformity with the directive organs of the republic, during the current five-year plan it will be necessary to fund construction-installation works at 292.5 million rubles, including 183 million rubles for subdivisions of Kazakh SSR Mintyazhstroy and Minmontazhspetsstroy. Meanwhile, for the current

year, for a specified assignment of 54 million rubles, the construction-installation is actually being fulfilled at 42 million rubles, although the annual plan in the total volume of construction is being fulfilled by 107%.

A similar position shows up with respect to this combine for 1982. The republic Mintyazhstroy plans to fulfill construction-installation works with only 19.6 million rubles with an established assignment of 35 million rubles, or 1.7 times less.

Total results of the work of constructors during 1981 and accepted plans for 1982 make it possible to conclude that assignments with respect to the volume of construction-installation works, which are fulfillable by the contract method for the current five-year plan both with respect to the Dzhezkazgan and Balkhash mining-metallurgical combines and the Akchatau and Zhayrem mining-concentration combines, have been only half fulfilled. In other words, part of that which was to be fulfilled during years of the 11th five year plan by subdivisions of Kazakh SSR Mintyazhstroy and Minmontazhspetsstroy voluntarily or unvoluntarily will be transferred to the 12th five-year plan; this means that a number of the most important plants for the mining of ore will be constructed only after considerable delays.

It appears that at the Kazakh SSR Mintyazhstroy, Minmontazhspetsstroy and Mintsvetmet, the situation which is developing with regard to construction of nonferrous metallurgy plants of our oblast is well-known. All necessary measures should be taken to ensure that plans correspond to the assign ents made by the directive organis of the republic. A special responsibility lies with organizations of Mintyazhstroy and the construction union of 'Dzhezkazgantyazhstroy" and its trusts, which should bring the mean annual volume of works being fulfilled in nonferrous metallurgy alone to 90-95 million rubles, i.e., double the 1981 level.

Of course, such growth in the volume of works is impossible without the active help of Kazakh SSR Mintyazhstroy. It is appropriate to remember this: at the November (1981) Plenum of the CC CPSU it was noted that it is necessary at the beginning of construction to provide a maximum concentration of labor, material and financial resources and to provide everything that is required for rapidly bringing the plant into operation. To do this, it will be necessary to increase the mobility of the construction organizations and to carry out the timely relocation of equipment and personnel. Therefore, once again I emphasize that without the specific and comprehensive help of Kazakh SSR Mintyzahstroy, until individual trusts for the construction of plants of nonferrous metallurgy in our oblast are relocated, it will be difficult to count on the success of the matter and the dynamic development of the raw-material base of the leading branch of the republic.

The industrial nonferrous metallurgy collectives of the oblast accepted their socialist obligations for the successful fulfillment of the plan

for 1982 and assignments of the five-year plan as a whole for the 60th anniversary of the formation of the USSR, and they planned for new height limits. They are reinforced by the necessary political and high-volume work at the sites by the party, trade-union and komsomol organizations, which are mobilizing the workers for the unconditional fulfillment of these obligations.

9978
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POWDER METALLURGY WILL EXPAND IN FUTURE

Moscow EKONOMICHESKAYA GAZETA in Russian No 26, Jun 82 p 14

[Article by V. Denisov: "Powder Metallurgy Today and In Perspective: a Review"]

[Text] Recently, mechanical engineers have paid more and more attention to powder metallurgy. The possibility of producing materials with properties assigned beforehand attracts the designers. The high utilization factor of metal in the manufacture of products impresses technologists. Production workers are enticed with the ease of the recovery of worn-out parts by surfacing and deposition. The advantages of powder materils have already been realized in practice by many plant collectives.

The main organizations responsible for the development of designs of assemblies, mechanisms and instruments for powder metallurgy are specified now in the machine-building branches. Forming, electrothermal, crushing, sorting, mixing, grinding, and other equipment have been approved for manufacture in the next ten years. The structure and regional disposition of scientific centers for the creation of new industrial processes for applying coatings have been crystallized. Assignments for producing products from metal powders and industrial equipment for the development of production capacities are an integral part of the state plan of the 11th Five-Year Plan. Two conferences, in September 1980 in Kiev and in March 1982 in Moscow, were held concerning probiems of powder metallurgy.

Regarding the "OTs 011" Program

The State Committee on Science and Technology developed together with interested ministries and departments a specific comprehensive scientific and technical program, "OTs 011," for the development of progressive technology. In particular, it calls for the industrial development during the 11th and 12th Five Year Plans of about fifty new industrial processes and the creation of more than twenty models of basic equipment and more than ten kinds of materials. More than forty ministries and departments will be involved in implementation of the program.

At plants of many machine-building branches - Minavtoprom [Ministry of the Automobile Industry], Minelektrotekhprom [Ministry of Electrical Engineering

Industrial], Minkhimmash [Ministry of Chemical Machinery Manufacture], Minenergomash [Ministry of Power Machinery Manufacture], and Minstroydormash [Ministry of Construction and Road Machinery Manufacture], work has been intensified in recent years on the use of parts from sintered powders and the use of progressive materials for deposition and surfacing. In the past year the production of products from metal powders was increased by more than 10% as compared with 1980.

The production possibilities of plants of USSR Minchermet [Ministry of Ferrous Metallurgy] which produce powder materials have grown. New machinery was put into operation at the Brovary plant, the SIU [Scientific and Industrial Union] "Tulachermet," workships of high-speed steel from metal powders at the "Dneprospetsstal'" plant, and at workshops for surfacing materials at the Torez plant of USSR Mintsvetmet [Ministry of Nonferrous Metallurgy].

In fulfilling the specific comprehensive scientific and technical program, the Minstankoprom [Ministry of the Machine-tool Industry] organized the production of a number of new forge-and-press machines. Now the stock of press equipment for powder metals has exceeded 2,500 units in our country. Thus with the number of presses in double-shift operation, according to calculations of specialists, it is possible to process up to 200,000 tons of powders per year. Work for creating new types of press machines is being continued.

Industrial unions and plants of Minelektrotekhprom developed the production fo sixty kinds of electrothermal furnaces; technical documentation is still being prepared on 24. Mintyamash [Ministry of Heavy Machinery Manufacture] is developing the manufacture of magnetic separators, grinders and mixers.

The "VNIIavtogenmash' [All-Union Scientific Research Institute of Gas Welding and Cutting of Metals] of Minkhimmash [Ministry of Chemical Machinery Manufacture], jointly with the Czechoslovakian firm ChKD [expansion unknown] "Poluprovodniki", created the KDM-2 arc metal spray gun for the spraying of powders. It is supplied by the Barnaul hardware-mechanical plant in a complete set with electrical engineering and auxiliary equipment. The "Magnit" union of Minpribor [Ministry of Instrument Manufacture] has begun to develop specialized products of complex shape from sintered magnetically soft and magnetically hard materials.

It would be possible to cite a great many similar examples. They indicate the following: powder metallurgy is gathering force, it encompasses an ever greater number of branches and it is being developed in new directions.

Fruits of Disagreement

However, it would be incorrect not to see those shortcomings, incomplete works and difficulties which retard progressive matters. First of all, the disagreements of different ministries has an effect. This applies both to the production and consumption of powder materials. New plants and workshops

of powder metallurgy should deliver their production to a large range of machine-building plants. But the latter plants at times are not ready for this. There is a lack of the necessary equipment, and the list of products to be manufactured by powder metallurgy is not defined. Therefore, in a number of cases the machine-building ministries present unfounded "ceiling" figures of the planned consumption of powder materials. For example, in 1982 USSR Minchermet could deliver two thousand tons of alloyed powders for products and gas-thermal spraying. It is considered that in the past year the "Tulachermet" union had a production capacity of four thousand tons of similar powders.

USSR Gosplan provided for 1200 tons in the annual plan. And how many orders from the machine-building consumer ministries arrived at USSR Minchermet? Only for 600 tons. It is easy now to explain the paradox: the machine builders were not prepared for the use of a large quantity of alloyed powders.

Certain forms of the press and electrothermal equipment being produced now are updated. Their main shortcoming are low operational characteristics in comparison with foreign models.

At the All-Union Conference on Powder Metallurgy in March of this year, Minstankoprom reported that models of presses built in the 11th Five-Year Plan have a productive capacity one and a half times greater than existing ones. This is true, but the new presses, nevertheless, are inferior to foreign presses with respect to level of automation, quality of manufacture and reliability: the ministry continues to deliver presses without industrial equipment and aspirators.

The equipment being produced does not satisfy the customers as to force, productivity, and certain other parameters. The production of automata for the pressing of parts of complex shape with several transitions through height has not been mastered.

Workers of Minstankoprom are obligated to draw practical conclusions from criticism. The branch has available sufficient technical potential to satisfy completely the needs of powder metallurgy.

Individual customers rightly complain of the low quality of furnaces for sintering products from powders supplied by Minelektrotekhprom. For example, series-produced furnaces of the STN type are unreliable due to design deficiencies, and, therefore, a large part of the time they are undergoing repair. Up to now, the manufacture of furnaces for the annealing of powders has not been organized. Minelektrotekhprom plans to develop series production of hgihly productive conveyor and pusher-type furnaces for the sintering of products no earlier than 1985. The shortage of certain other types of industrial equipment continues. The following are not serially manufactured: equipment for the oil-impregnation of metal powder products, presses for the finishing of stepped parts, and apparatus for the remote control of plasma spraying.

Individual branches began to produce inadequate machines and mechanisms. They were of low quality, yet were expansive. For example, during the last three years, plants of Minavtoprom [Ministry of the Automobile Industry] independently designed and manufactured 39 different presses, 15 sintering furnaces and certain types of mixing-processing equipment. In the past year, the "TsNIITmash" SIU of Minenergomash [Ministry of Power Machinery Manufacture] manufactured four hundred sets of gas-oxygen burners for powder spraying in the repair of water heaters.

Requests Did Not Arrive

Often the actions of the ministries on problems of the manufacture of equipment resemble a discordant chorus. Mintyazhmash was commissioned in the past year to carry out the creation of specialized isostatic curves for the production of semifinished products from composite materials. However, in practice nothing has been done in this direction up to now. Why? There are no technical assignments and no requests from USSR Minchermet and USSR Mintsvetmet. The reason is that at both ministries the standard dimensions and the demand for the appropriate equipment were not specified.

It is impossible to suppress the fact that the introduction of progressive industrial processes is made difficult because of the low quality of iron powders. Powders of brands PZh4 and PZh5, supplied by USSR Minchermet, do not satisfy the necessary requirements with respect to the content of oxygen and carbon, and also extrudability, fluidity, and chemical purity, and it is impossible to manufacture important parts from them. Powders of brands PZh2 and PZh3 possess higher quality, sufficient production of them during 1982-1983 has not been planned.

Alloyed powders for spraying do not satisfy the needs of machine builders with regard to a number of physicomechanical properties. There is still no industrial production of sprayable composite powders. Meanwhile, the assembly of a complex line at the Torez plant for hard surfacing alloys has been greatly delayed.

There exists a disproportion between the volume of production of iron-based powders and the volume of their use at a number of machine-building branches. Lack of coordination and disagreements in the course of implementation of the specific scientific and technical program, remain to be solved.

The main problem now is to concentrate the efforts of specialists of branch institutes and engineering and technical workers of machine-building plants on preparations for increasing the use of powders, the large-tonnage output of which will be developed starting in 1984.

In the interests of expanding the development of the technology of sintering, deposition and hard-facing of metal powders, experimental-demonstration sections are presently being developed. It is expedient for the branch institutes to take the work of these sections under their supervision.

The great industrial potential which is available to our machine building industry and the high qualitifications of the personnel engaged in powder metallurgy both in academic and branch institutes as well as in production give every assurance that the new progressive industrial processes will be strengthened.

This year the production of products from metal powders at plants of Minelektrotekhprom and Minpribor has increased by a factor of 1.4 as compared with 1981; production at plants of Minstankprom was increased by 1.3 times. The elimination of existing shortcomings will make it possible to accelerate the formation of a progressive branch.

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POWDER TECHNOLOGY SPECIALIST TRAINING URGENTLY NEEDED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 3 Jul 82 p 2

[Article by Doctor of Technical Sciences and Professor B. Mitin, rector of Moscow Aviation Technical Institute imeni K. E. Tsiolkovskiy: "Order for Specialists"]

[Text] There can no longer be any doubt: the future belongs to the technology for obtaining metal-powder products. A whole complex of advantages, many associated with the concept of "waste-free", speak in favor of it: due to the precision of their manufacture, subsequent machining of powder items can be sharply reduced, sometimes even eliminated entirely. Experience has demonstrated that the use of 1,000 tons of powder saves an average of about 2,000 tons of rolled metal, frees up to 80 machine tools for other work, and lowers the labor-intensiveness of manufacturing items by 30-60 percent. Capital expenditures on setting up production of the items are also reduced correspondingly, two- to three-fold.

Neither can we fail to stress the degree of influence powder technology has on technical progress in the leading branches, on the level of the machinery, devices and equipment being developed. It is often only using such methods that we can obtain items, materials and coatings with improved, sometimes unique, properties: superhard and high-temperature strength, filtering, friction and antifriction composites, and materials with special magnetic and other properties.

One of the comprehensive scientific-technical programs developed by the USSR State Committee for Science and Technology, jointly with the USSR Academy of Sciences and the union Gosplan, is oriented towards developing powder technology. Many assignments in this program must conclude this five-year plan with the introduction of new methods and equipment.

It is to the point to ask who will introduce them.

It is not an idle question, at the least because in the dispute "to be or not to be" which accompanies the introduction of innovations, real difficulties are always stronger than promised advantages. And many of the difficulties and failures in mastering powder technology arise time and again due to the fact that this matter is entrusted at the enterprises to people without appropriate training. In their defense, it should be said that they have done everything which

depended on them. But enthusiasm, as we know, is no substitute for skill and experience, especially when the reference is to mastering fundamentally new and often delicate technological processes. And there are clearly too few specialists in powder technology in industry.

How did this happen? The traditional explanation, that there is a certain inertia inherent to higher education which renders it incapable of advancing the development of science, is hardly valid in this instance. It was in fact in the VUZ's that much of the research and development in the field of powder technology was first begun and successfully continues. Moreover, it was at its own risk that higher education began training specialists in this field: instruction in the principles of powder metallurgy was instituted in metallurgical specialties first at the Moscow Institute of Steel and Alloys and later at Kiev, Belorussian and Perm' polytechnic institutes.

Unfortunately, this initial momentum was not continued as appropriate to the rates of research and development in the field of powder technology. It was only in 1980 that the USSR Gosplan finally adopted a USSR Ministry of Higher and Secondary Special Education proposal and approved the new specialty, No. 0414, of "Powder Metallurgy and Spray Coatings".

So late a decision is largely to be explained by the fact that up until a certain moment, there was no corresponding "specialists order" on the part of a majority of the branches of industry. And even now, by no means all leaders of ministries and departments at whose enterprises powder technology must register are displaying an interest in training such specialists. One reason is that they imagine this technology is as it was a quarter of a century ago. At that time, its entire arsenal of methods reduced essentially to the following: powders obtained by reducing metal oxides were pressed into molds and sintered in thermal furnaces. Metallurgical specialists were well-able to cope with mastering this technology with a minimum of training in this field.

Since that time, the situation has changed radically. With the appearance of plasma, autoclave and other modern methods, it has become possible to obtain powders of the most varied metals and alloys, with prescribed structures and other particle parameters. Chemically pure and highly plastic, they have turned out to be suitable for manufacturing critical, complexly-shaped items with excellent physicomechanical properties. But the old pressing methods are no longer suitable, as they do not ensure even compression of the entire part. They have been replaced by such processes as explosion molding, hydrostatic pressing, electromagnetic and electrical-impulse molding. In other words, it is practically an entirely new branch of technology which has arisen, with only the name remaining from what was formerly called powder metallurgy. And the demands as to depth of training for specialists concerned with mastering the new methods have also changed correspondingly.

The shortage of such specialists was especially perceptible when an independent line of powder metallurgy, applying functional and protective coatings, began developing. Research showed that in order to give parts the properties needed, it was in many instances entirely unnecessary to make the whole item of expensive powder, that it was sufficient to apply only a thin layer on the main working surfaces. True, practical realization of this alluring concept required the

development of special equipment to obtain various coatings -- plasma, flame-spraying, detonation, equipment for combined rolling. The subtleties of these processes naturally would hardly be familiar to technologists with ordinary training.

The present level of knowledge concerning these and other promising methods is to be covered by the new specialty "Powder Metallurgy and Sprayed Coatings". The study plan for it has been worked out by Moscow Aviation Technical Institute and Belorussian Polytechnic Institute. The day and evening divisions of the Moscow Institute of Steel and Alloys and the Kiev and Perm' polytechnic institutes have also joined these VUZ's in offering training in the new specialty. Other VUZ's will apparently also soon begin training specialists in powder technology. Finally, a standing commission composed of representatives of the higher schools, scientific institutions and industry has been formed to resolve questions of training content and methodology in this specialty.

Everything necessary would seem to have been done. But the time.... The first graduation in this specialty will not be until 1985. In other words, graduates with the appropriate training will reach enterprises at the end of the five-year plan. But we need to be mastering the new methods and equipment today. Who will do it?

A way out has been found thanks to the joint efforts of the USSR Ministry of Higher and Secondary Special Education and a number of the ministries concerned: last year, a special faculty was organized at our institute to accept engineers with work experience at enterprises and in scientific and design organizations. They studied twice a week in time away from production. The whole course is to take 18 months. The first graduates will thus complete it this year.

Leading scientists from USSR Academy of Sciences institutes, branch scientific research institutes and VUZ's have been enlisted in instructing at this special faculty. With their help, the students both receive thorough theoretical training and master the operation of modern experimental and industrial equipment. The training concludes with the practical introduction of powder technology methods at enterprises to which special-faculty students are sent.

One might ask in what light the creation of such a special faculty should be viewed. As a forced emergency measure or as experience in setting up the training of specialists in new scientific-technical directions, which experience must be further developed and achieve general recognition? In our view, the second view is more justified.

Given the high rates of scientific-technical progress and the broad research front, the development of personnel situations similar to those which evolved in the field of powder technology is possible in many other directions as well. It can be anticipated that the demand for specialists with corresponding training will be especially high when new methods and equipment are being widely introduced. Then, as the field fills, it will decrease to a somewhat stable level. And it is evidently towards that stable demand that higher education must orient itself when setting up new specialties. But the "peak" demand for specialists can be met more easily, faster and with lower expenditures by our type of special faculty.

Consideration should be given to the fact that we have until now been speaking basically about powder technology specialists capable of mastering new methods and equipment. The latter is quite specific and often has no analogs in other branches. Who will develop it? The developers of the new methods themselves are currently forced to resolve this task: no one is training designers and constructors. But a special faculty at a leading VUZ such as the MVTU [Moscow Higher Technical School imeni N. E. Bauman] could quickly close this "breach."

On the other hand, given a broad network of special faculties, the study courses of each could be precisely oriented towards those particular powder technology methods which will be used in a specific branch. Finally, these courses could efficiently reflect the main innovations, whose development is now being done only within the framework of the comprehensive scientific-technical programs.

In a majority of instances, it is proper for these very programs to predetermine the schedules and scales for introducing fundamentally new techniques and technology. In other words, they indirectly contain information on future requirements for particular specialists. Why, then, not concretize this information in order to avoid personnel problems. We think, though, that the USSR State Committee for Science and Technology should include a "specialists order" in the scientific-technical programs and provide correspondingly for their training. As is known, without people, any technique risks being useless.

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SINTERING OF TUNGSTEN AND RHENIUM POWDER MIXTURES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 82
(manuscript received 1 Apr 81) pp 31-35

SOLONIN, S. M. and KIVALO, L. I., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study was made of the variation of shrinkage and alloy formation upon sintering of mixtures of rhenium and tungsten powder as a function of concentration. As sintering time was increased from 0.5 to 2.5 h, the volumetric shrinkage (particularly of tungsten based alloys) increased, though the nature of the variation did not change. It was monotonic for mixtures with coarse tungsten powder and had a minimum for mixtures with fine tungsten powder. X-ray diffraction studies showed that the use of the fine tungsten powder results in more intensive formation of alloys rich in tungsten. The variation in concentration dependency as a function of particle size is related to the more intensive diffusion interaction in smaller powder which apparently facilitates the appearance of the inhibiting influence of the Frankel effect. Figures 4; references 5: all Russian.
[160-6508]

UDC: 621.762

PROPERTIES OF R6M5 STEEL POWDERS WITH VARIOUS GRANULARITIES AND STRUCTURE OF SINTERED STEEL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 82
(manuscript received 22 Apr 81) pp 9-15

KIPARISOV, S. S., TRET'YAKOV, V. I., PANOV, V. S., SMIRNOVA, M. M. and KOTS, Yu. F., Moscow Institute of Steels and Alloys

[Abstract] This article is dedicated to refining conditions of pressing and sintering as a function of powder particle size. The pressability

and sinterability of R6M5 steel powders with particle sizes of 100, 54 and 22 μm were studied. The initial powders were produced by grinding scraps of high speed steel in a ball mill. A solution of synthetic rubber in gasoline was added before pressing to improve moldability and pressability. Pressures of 700-800 MPa were found to be necessary to produce strong, compact briquettes with relative density 70 to 75%. The kinetics of compacting of specimens of various grain size during sintering were studied. Production of 97-98% relative density required a temperature of 1240°C for 100 μm particles, 1220 for 54 μm particles and 1200 for 22 μm particles. Fineness of the structure of the steel produced varied directly with powder particle size. The liquid phase appearing during sintering of steel powders has different shape and location for the different particle sizes. In the larger powders the eutectic is the same as in cast steel: for smaller powders it is finer and located uniformly throughout the structure in the form of thin plates. Figures 4; references 7: all Russian.
[160-6508]

UDC: 537.534

COMPARATIVE STUDY OF LASER EVAPORATION OF CdSe SINGLE CRYSTALS AND METALLIC Cd

Moscow POVERKHNOST': FIZIKA, KHIMIYA, MEKHANIKA in Russian No 6, Jun 82 (manuscript received 19 Oct 81) pp 148-150

LAZNEVA, E. F. and ALEKSANDROV, I. N., Leningrad State University imeni A. A. Zhdanov

[Abstract] Studies were performed in a high vacuum using cadmium selenide single crystals with a ruby laser operating in the Qumodulation mode as the light source. Light pulse length was ~50 ms. The wavelength λ = 694.3 nm is in the area of natural absorption of cadmium selenide. Evaporation of cadmium ions was analyzed by flight time mass spectrometry with two flight sectors. In the first sector the particles flying from the surface of the specimen were separated by flight time. Then monokinetic particle groups were distributed by masses in the drift space. Cadmium was used as the control object to eliminate semiconductor effects. The comparative studies showed that in the case of the metal the determining mechanism is that of thermal evaporation, while the semiconductor manifests two different emission mechanisms - thermal and semiconductor. The primary role in the latter mechanism is played by processes of recombination of photoexcited carriers accompanied by recharging of surface ions.
[149-6508]

UDC: 546.47'48'231:54-165

PRODUCTION AND STUDY OF LARGE SINGLE CRYSTALS OF $Zn_xCd_{1-2}Se$ SOLID SOLUTIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 18, No 6, Jun 82 (manuscript received 23 Jun 81) pp 908-912

BUDENNAYA, L. D., NIZKOVA, A. I., PEKAR', G. S. and POLISSKIY, G. N., Institute of Semiconductors, Ukrainian Academy of Sciences

[Abstract] A report is presented on the production of large perfect single crystals of a $Zn_xCd_{1-2}Se$ solid solution where $1 \geq x \geq 0$, and results of the study

of a number of characteristics are presented. The single crystals were grown in 20 different compositions as cylinders up to 400 mm in diameter and 30 mm in length, weighing as much as 200 g. The total growth time was not over 22 hours. The method of free growth in the gas phase was used, even though the saturated vapor pressure of the components differed significantly at the growth temperature. The characteristics were found to be quite homogeneous throughout the crystals. Figures 2; references 12: 9 Russian, 3 Western. [159-6508]

UDC: 548:536:539.216.2

THERMAL EXPANSION OF THIN GOLD FILMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 82 (manuscript received 25 Nov 80) pp 121-122

PUGACHEV, A. T. and CHURAKOVA, N. P., Khar'kov

[Abstract] An experimental study is presented of the thermal expansion of polycrystalline gold films 50 to 100 angstroms thick. First a method was developed to determine the coefficient of thermal expansion by diffraction of fast electrons passed through the material at temperatures of 80 to 300°K. Films were produced by evaporation and condensation at no less than 100 angstroms per second in a vacuum of 10^{-5} mm Hg on a sitall base with a sublayer of NaCl at 300°K. The structure and morphology of the films was studied by electron microscope examination. The coefficient of linear expansion was found to be 15 to 20% higher than that of massive gold, a dimensional effect resulting from the influence of surface and subsurface layers on the thermal expansion of thin films. Figures 2; references 8: 6 Russian, 2 Western. [156-6508]

UDC: 669.15'24:539.216.2:538.56

DOUBLE-FREQUENCY EXCITATION OF MAGNETIZATION OSCILLATIONS IN THIN MAGNETIC FILM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 5, May 82 (manuscript received 3 Jul 81) pp 917-920

POL'SKIY, A. I., RIZUNENKO, V. I., TYURNEV, V. V. and YAKOVCHUK, V. Yu., Institute of Physics imeni L. V. Kirenskiy, Siberian Branch, USSR Academy of Sciences

[Abstract] A study is made of the specifics of conversions arising upon excitation of magnetization oscillations in a thin magnetic film by two variable magnetic fields at 900 and 970 MHz. Studies were performed on film

specimens 80% Ni, 20% Fe, 0.3 μm thick. Angular anisotropy disperson was 1.7 to 2.2°, saturation magnetization ~650 gauss. Excitation of oscillations resulted from the nonlinear nature of movement of magnetization appearing at all amplitudes of the variable magnetic fields. A peak of oscillations is observed in fields with $H_0<H_k$ with narrow line width. Figures 3; references 3: all Western.
[147-6508]

UDC: 669.21:539.216.2:620.187.3:548.73

LATTICE AND SUBSTRUCTURE DYNAMICS IN THIN CONDENSED GOLD FILMS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 5, May 82 (manuscript received 2 Dec 80, in final form 25 Jun 81) pp 911-916

PUGACHEV, A. T., ARINKIN, A. V., CHURAKOVA, N. P. and CHEREMSKOY, P. G., Khar'kov Polytechnical Institute imeni V. I. Lenin

[Abstract] A combined study is made of the Debye temperature, mean square displacement of atoms, thermal expansion coefficient and substructure of 10 to 100 nm thick gold films in the 80 to 300°K temperature interval. The gold films were obtained by evaporation and condensation in a vacuum of ~10^{-3} Pa on unheated sitall substrates with an underlying layer of KCl. The film structure was studied by electron microscope and x-ray diffraction analysis. Gold films thicker than ~7 to 10 nm were continuous polycrystalline films. The [111] axis was primarily oriented perpendicular to the plane of the film. One characteristic feature of Au films was their high content of submicroscopic pores. For the interval of thicknesses studied there was good agreement between x-ray and electronographic data concerning the variation of Debye temperature as a function of thickness. Above 10 nm the Debye temperature is less dependent on thickness than in very thin films, <10 nm thick. The diffraction studies indicated that the effect of relative change of the lattice parameter with film temperature was independent of the indices of reflecting planes and was inverse to temperature. Figures 3; references 13: 8 Russian, 5 Western.
[147-6508]

UDC: 669.017

INFLUENCE OF HYDROGEN ON STABILITY OF TITANIUM MARTENSITE IN PLASTIC DEFORMATION

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 82 (manuscript received 6 Apr 81) pp 86-90

KOLACHEV, B. A., FEDOROVA, N. V., MAMONOVA, F. S. and PIMENOVA, A. Z., Department of Metal Science and the Hot Working of Metals, Institute of Aviation Technology, Moscow

[Abstract] Methods of x-ray structural and metallographic analysis are used to study the influence of the degree of deformation by expansion and upsetting on the stability of martensite in the alloys Ti+6% Mo and VT6 (Ti+6% Al+4% V) with various contents of hydrogen. Martensite breakdown under the influence of stresses in the extended specimens was studied in the direction of the axis of deformation at various distances from the fracture point. It was found that the martensite decomposition in the alloy with 6% Mo depends not only on the degree of deformation but also on the stress state diagram. In areas of uniaxial extension martensite breaks down to form the deformed α'' phase plus the β phase, while in the neck area the hardened α'' phase forms the α'' deformed phase plus β phase and then the α'' deformed phase. In specimens with hydrogen the β phase formed in the initial stages of extension is not converted to deformed martensite due to the β stabilizing effect of hydrogen. Deformation of the alloy with 6% Mo by upsetting results in breakdown of the rhombic martensite to the $\beta_0 + \omega + \alpha$ phases. Hydrogen decreases the stability of the α'' martensite phase in both upsetting and extension. The α' martensite of VT6 is stable in extension to fracture at room temperature and in upsetting to 10% deformation. Further deformation produces an impoverished α' phase and the β phase. Hydrogen at 0.015 and 0.05% decreases the stability of the martensite in VT6 alloy during upsetting. Figures 3; references 7: all Russian.
[162-6508]

UDC: 669.295'71'296'28:620.17

MECHANICAL PROPERTIES AND STRUCTURE OF Ti-Al-Zr-Mo ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3,
May-Jun 82 (manuscript received 27 Jan 81) pp 220-222

RYABTSEV, L. A. and TARASOVA, O. B., Moscow

[Abstract] A study is made of the influence of molybdenum on the mechanical properties and structure of titanium alloys based on a trinary α-solid solution containing 7% Al and 1% Zr after two types of heat treatment. Ingots were prepared from electrodes pressed on a 10 ton press by double remelting in a vacuum arc furnace. The ingots were turned to remove surface defects and three samples taken for chemical analysis (from the head, middle and bottom of the ingots) and averaged. The ingots were heated in an electric furnace at 1200°C for 40 minutes then forged on a 400 kg hammer into bars 15 mm in diameter which were then heat treated by annealing at 800°C, 1 hour, cooling in air or by hardening from 1100°C, 1 hour, cooling in oil. The structure and mechanical properties were studied at room temperature and at 600-900°C. The introduction of molybdenum at up to 3% increases the strength at room temperature from 950 to 1200 MPa, the yield point from 900 to 1150 MPa after annealing and cooling in air. Further alloying with molybdenum does not increase the strength properties but reduces ductility. The alloy with 5% Mo is most hardened by the second heat treatment used, with the ultimate strength reaching 1450 MPa. Figures 3; references 4: all Russian.
[156-6508]

UDC: 621.791.01:539.3783:6699295

SPECIFICS OF STRUCTURE OF DIFFUSION WELDED JOINTS OF TITANIUM ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 82
(manuscript received 16 Oct 80) pp 89-92

GEL'MAN, A. A., SEMENOVA, N. M., MOZOLEVSKAYA, O. A. and GOLUBEVA, G. V., Moscow

[Abstract] A study is presented of the specifics of the structure of the contact zone of joints with various levels of impact toughness, having plate and coarse fiber initial structure by means of light and electron microscopy. Studies were performed on specimens of the VT6 two phase titanium alloy with ratio of impact toughness of the welded joint to impact toughness of the base metal of 0.12-1:1. When common recrystallization grains were not present in the joint the level of impact toughness was close to the base metal due to mutual intergrowth of α-plates in the planes joined. The intergrowth process is facilitated by preliminary deformation

of the metal in the $\alpha+\beta$ area and by long vacuum annealing at the welding temperature after completion of the welding cycle. Metallographic and fractographic analysis show that joints are formed nonuniformly over the contact area up to the completion stage of formation. Figures 3; references 2: 1 Russian, 1 Western.
[156-6508]

UDC: 543.422

SURFACE COMPOSITION UPON OXIDATION OF TITANIUM AND ITS ALLOYS

Moscow POVERKHNOST': FIZIKA, KHIMIYA, MEKHANIKA in Russian No 6, Jun 82 (manuscript received 26 Jun 81) pp 75-80

AKIMOV, A. G. and DAGUROV, V. G., Institute of Physical Chemistry, USSR Academy of Sciences, Moscow

[Abstract] The current literature data include no precise representation of the mechanism of formation, quantity and distribution of oxide phases formed during oxidation of titanium and its alloys at high temperatures. This work was performed to fill this gap, studying the basic regularities of the oxidation of titanium and its alloys at elevated temperatures by x-ray electron spectroscopy. Alloys of titanium with 6% aluminum and with 10% nickel were studied, since these alloying components have greater (for aluminum) and less (for nickel) affinity for oxygen than does titanium, and the alloying elements selected should have a different influence on the oxidation process. The aluminum alloy is an α' phase alloy. Plate specimens of polycrystalline titanium or alloy measuring 10 x 8 x 1.5 mm were oxidized for 1 hour at an oxygen pressure of 10^{-5} mm Hg. The x-ray electron spectra produced can be explained by assuming that at 350-400°C the martensitic α' phase breaks down to $\alpha+\beta$ phases so that oxidation of titanium-nickel alloy in the temperature range above 300°C involves the production of a β phase in the metal substrate. The products of oxidation are TiO_2, TiO and suboxides. Ti_2O_3 is also formed when the nickel alloy is oxidized at 400 to 500°C. The growth of the TiO_2 film is determined by diffusion not only of oxygen, but also of titanium cations. The growth kinetics correspond to the cubic law of oxidation. The phase composition of the titanium alloys may have a significant influence on the formation of oxide layers. Figures 4; references 25: 11 Russian, 14 Western.
[149-6508]

UDC: 669.295'293'782'783:537.312.62

STRUCTURE AND SUPERCONDUCTING PROPERTIES OF TITANIUM-NIOBIUM ALLOYS WITH SILICON AND GERMANIUM ADDITIVES

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 5, May 82 (manuscript received 20 Jul 81) pp 921-930

VOZILKIN, V. A., KORZHOV, V. P. and TRENOGINA, T. L., Institute of Metal Physics, Urals Science Center, USSR Academy of Sciences; Institute of Solid State Physics, USSR Academy of Sciences

[Abstract] A study is made of structural changes which occur during aging of hardened titanium-niobium alloys with various contents of silicon and germanium. They are compared with changes in critical current density and transition temperature to the superconducting state. To avoid difficulties in the interpretation of the results, several alloys were selected which do not undergo β to ω or β to α conversions when germanium of silicon are not present. The critical points were measured on strip specimens in a superconducting solenoid at 4.2°K in a magnetic field perpendicular to the transport current and parallel to the rolling plane of the strips. In the Ti-Nb-Ge and Ti-Nb-Si systems breakdown of the β-solid solution is accompanied by liberation of an intermediate germanide or silicide γ' phase. In alloys based on Ti with 40% Nb and 47% Nb simultaneous liberation of α and γ' phases occurs. It is established that the highest values of critical current density in magnetic fields of 55 KOe result from liberation of germanide of silicide phase particles measuring ~200 nm, the maximum rate of formation of which occurs at ~600°C. Figures 8; references 10: 5 Russian, 5 Western.
[147-6508]

UDC: 621.791.4:539.378(047)

DIFFUSION JOINING OF MATERIALS (REVIEW)

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 82
(manuscript received 3 Jul 81, in final form 5 Jan 82) pp 42-46

KAZAKOV, N. F., doctor of technical sciences, Institute of Aviation Technology imeni K. E. Tsiolkovskiy, Moscow

[Abstract] This review discusses diffusion welding in the solid state, a method of producing monolithic joints of materials by the development of bonds at the atomic level appearing as the contact surfaces are brought as close together as possible by local plastic deformation and simultaneous heating assuring mutual diffusion of atoms in the surface layers of the materials being joined. The main parameters of the process are temperature, pressure and time, determined by the physical-chemical and mechanical properties of the materials, condition of the welded surfaces and structure of the welded joints. Photographs, including some cross sectional cutaway models, are presented of parts produced by diffusion welding of copper onto aluminum, silver onto steel and copper onto ceramic. A diffusion welding vacuum installation with induction, radiation and contact heating and electromechanical loading allowing automated welding is shown. Approximately 100 types of diffusion vacuum welding installations using various heat sources and loading systems have been developed in the USSR. The future of the method will be determined by the scale of series production of universal equipment with programmed control, welding robots and supplementary equipment. Figures 8; references 11: all Russian.
[161-6508]

UDC: 621.791.4.052:539.378.3:669.295.018:620.18

INFLUENCE OF INITIAL MICROSTRUCTURE ON FORMATION OF JOINTS IN DIFFUSION WELDING OF HONEYCOMB STRUCTURES OF OT4-1 TITANIUM ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 82
(manuscript received 16 Dec 81, in final form 5 Feb 82) pp 27-31

PESHKOV, V. V., candidate of technical sciences, and KUDASHOV, A. O., engineer, Voronezh Polytechnical Institute

[Abstract] A study was made of the influence of initial titanium microstructure on the stress at which stability is lost by a honeycomb unit being welded. The stability loss stress was determined in specimens measuring 100 x 70 x 20 mm with hexagonal honeycomb structure in compression for 90 minutes at 800 to 1000°C. The influence of initial microstructure of the welded elements of the honeycomb structure on the formation and strength characteristics of joints was studied using the honeycomb specimens and also cylindrical tubular specimens imitating a single honeycomb cell. It was found that the use of a honeycomb filler with large grain plate structure allowed the compressive force used during welding to be increased by a factor of 5 in comparison to a filler made of a material with equiaxial fine grained structure. Welding of two elements of the same alloy but with different microstructures must be considered welding of dissimilar materials. In diffusion welding of honeycomb structures the process of joint formation with strength characteristics at the same level as the base metal is achieved only when the sheathing is a material with fine grained structure, the filler is a material with large grained plate structure with dimensions such that δ_f/δ_s is not over 0.35. Figures 6; references 9: all Russian.
[161-6508]

UDC: 621.791.4.052:539.378.3:[669.295+669.3]

STRUCTURE OF JOINTS OF TITANIUM WITH COPPER MADE BY DIFFUSION WELDING WITH VARIOUS DEFORMATION SCHEMES

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 82
(manuscript received 15 Oct 81, in final form 5 Jan 82) pp 21-23

LARIKOV, L. N., doctor of technical sciences, and BELYAKOVA, M. N., candidate of technical sciences, Institute of Metal Physics, Ukrainian Academy of Sciences; ZAMKOV, V. N., candidate of technical sciences, and SABOKAR', V. K., engineer, Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] The purpose of this work was to study the influence of two deformation schemes at 480 and 550°C on structural transformations in contact layer metal during welding of titanium and copper. Structural analysis

showed that the copper in the contact zone undergoes dynamic recrystallization under load. The structure formed by welding has traces of deformation hardening. The dynamically recrystallized grains have less structural perfection than those produced after cold deformation and subsequent annealing. X-ray studies indicate that dynamic recrystallization produces metal not hardened by welding, there being a dynamic equilibrium between the generation and annilation of dislocations. Quality joints are achieved if deformation is accompanied by dynamic softening by dynamic recrystallization. Dynamic recrystallization of even one of the two metals joined eliminates the great macroscopic stresses resulting from the different physical and chemical properties of the metals welded. Figures 5; references 3: 1 Russian, 2 Western.
[161-6508]

UDC: 539.213.001

DISCLINATION MODEL OF PLASTIC DEFORMATION OF AMORPHOUS METAL ALLOYS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 3, Mar 82 (manuscript received 21 Oct 81) pp 622-626

ZAYCHENKO, S. G. and BORISOV, V. T., Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin, Moscow

[Abstract] The plastic deformation of an amorphous material begins with separation of dislocations from their points of attachment on disclinations with subsequent conservative slipping. The author has estimated the plastic flow stress for this model. An example of a single wedge disclination, a disclination dipole and a disclination wall is used to demonstrate their capability for emission and absorption of dislocations. A mathematical model of the process is analyzed. The example studied has a specific stress tensor component σ_{12}, but the model is applicable for a three-dimensional cubic network of wedge dislocation dipoles whose axes are parallel to the x and y axes, based on the geometric properties of the emitted dislocations and the axiality of the stress tensors of these disclination dipole systems. The emission of edge dislocations to the free surface forms slippage steps, which are experimentally observed. Figures 1; references 11: 3 Russian, 8 Western.
[111-6508]

UDC: 669.017:621.373.826

MASS TRANSFER DURING SURFACE TREATMENT OF METALS BY CONTINUOUS LASER BEAM MELTING

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 3, Mar 82 (manuscript received 16 Oct 81) pp 616-618

BOROVSKIY, I. B., GORODSKIY, D. D., SHARAFEYEV, I. M. and MORYASHCHEV, S. F., Institute of Solid State Physics, USSR Academy of Sciences, Chernogolovka, Moscow Oblast

[Abstract] In order to study the kinetics of the alloying process when surfaces are exposed to a continuous laser, mass transfer was studied in the systems Al-Fe, Cr-Fe and Ni-Fe with a specific incident CO_2 laser power on the order of 10^5-10^{-6} W/cm^2 in the radiation spot and continuous movement of the specimen at 1 to 5 cm/s. The studies showed that intensive movement of the melted metal occurs, with the melt moving at 5 to 15 cm/s at the edge of the liquid bath. Calculations performed for Fe with a melted zone 2 mm wide and 0.2 mm thick and a temperature difference in the central and edge portions at 500°C showed that the melted mass in the surface layer can move at a speed on the order of 1 to 3 m/s, with the internal layers moving at several tens of cm/s. Traces of moving carbon particles in a paraffin model are used to illustrate the mass transfer conditions which arise during laser treatment of metal surfaces. The mass transfer occurs due to the thermocapillary effect, regardless of orientation of the specimen in the field of the force of gravity. Figures 3; references 3: all Russian. [111-6508]

UDC: 669.291:669.849:661.3

EPITAXIAL GROWTH OF TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS FROM GAS PHASE

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 18, No 5, May 82 (manuscript received 5 Feb 81) pp 816-819

LAKHOTKIN, Yu. V. and KRASOVSKIY, A. I., Institute of Physical Chemistry, USSR Academy of Sciences

[Abstract] A study is made of the epitaxial growth of individual tungsten and tungsten-rhenium (W+6 mass % Re) seeds with solid solution structure on the primary faces of a tungsten single crystal. The study was to determine the forms of tungsten and alloy growth which occur with rhenium under actual fluoride method coating production conditions, the influence of rhenium during joint precipitation with tungsten on growth rate of crystals and the change in growth rate as a function of substrate orientation. Epitaxy was performed in a vacuum water cooled chamber with a molybdenum plate heater. The chamber walls were heated to 370°K so that

the reagents and intermediate products did not condense on the walls or disrupt epitaxy. The growth form of tungsten and tungsten plus rhenium solid solution seeds on the (100), (111) and (110) planes of tungsten corresponds to the equilibrium figure of growth of a body centered cubic metal - a rhombodecahedron. Upon precipitation of the alloy of tungsten plus 6 mass % rhenium the growth form of seeds has a clearer delineation and is more stable with the growth of seed size than when tungsten alone is precipitated. Alloying of tungsten with rhenium in the solubility area increases the growth rate of individual seeds, their density and layer thickness at which a solid epitaxial film is formed. The epitaxial film growth rate depends on the orientation of the substrate. Figures 3; references 8: 5 Russian, 3 Western.
[150-6508]

UDC: 669.21/23

TECHNOLOGY FOR EXTRACTING GOLD AND SILVER FROM RESISTANT SULFIDE CONCENTRATE WITHOUT ROASTING

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 3, May-Jun 82 (manuscript received 28 Sep 81) pp 39-42

MINEYEV, G. G., SYRTLANOVA, T. S. and SKOBEYEV, I. K., Scientific Research Institute of Rare Metals, Irkutsk; and Department of Noble and Light Metals, Irkutsk Polytechnical Institute

[Abstract] This article discusses the development of a technology for extracting noble metals from a concentrate of one of the deposits of Yakutia by means of jet crushing and subsequent hydrometallurgical processing. The concentrate studied contained 55 g/t Au, 260 g/t Ag, 5.4% As, 16.8% S and 10.0% C. The free gold did not exceed 6 to 8% and there was no native silver. Jet crushing was performed using compressed air. Sorption leaching in the presence of the anionite AM-2B was used to suppress secondary sorption of Au and Ag. The noble metals were extracted by cyanation after 48 hours' alkaline leaching. Cyanation is performed at a liquid-to-solid ratio of 4:1, NaCN concentration 0.4%, 48 hours. The leaching slurry was thickened and recycled to remove arsenic and allow its reuse. The gold and silver were then desorbed by standard industrial methods. The technology is recommended for large scale testing. Figures 2; references 2: both Russian.
[162-6508]

UDC: 669.27:621.7-982:534.8

PRODUCTION OF TUNGSTEN MICRON CROSS SECTION STRIPS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manascript received 11 Aug 81) pp 105-112

TYAVLOVSKIY, M. D. and KUNDAS, S. P., Minsk

[Abstract] One method of increasing the ductility of tungsten is high metallurgical purification, removing hydrogen and oxygen impurities. This makes it important to retain purity and thus ductility during later pressure working. An analysis of previous works indicates a clear trend toward simplifying tungsten working processes, including their performance in air without heating. The authors studied the influence of the flattening process in rolling on force characteristics, mechanical properties, surface quality and structure of microscopic tungsten strips produced from wire 0.056 to 0.25 mm in diameter. It was found that hot ultrasonic vacuum flattening produces technically pure tungsten strips with good mechanical properties. The vacuum must be at least $1.33 \cdot 10^{-1}$ Pa, temperature 1300 to 1500°K, amplitude of ultrasonic tool oscillations 5 to 10 μm, degree of compression of wire per pass 45 to 65% and flattening speed 0.1 to 0.6 m/s. Figures 4; references 19: 18 Russian, 1 Western.
[155-6508]

UDC: 669.784;669.71

WETTING OF CERTAIN CARBON MATERIALS BY ALUMINUM ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 16 Sep 80) pp 89-92

SHORSHOROV, M. Kh, SAVVATEYEVA, S. M. and SHEBO, P., Moscow, Bratislava

[Abstract] A study was made of the wetting of type 042 technical aluminum and aluminum-silicon alloys on the surface of type LU carbon fabric with preliminarily applied SiC, Mo, Cr and TiB_2 coatings, applied by precipitation from the gas phase onto pretreated carbon fabric surfaces. The contact wetting angle at the division boundary between aluminum alloy and the coating on the carbon strip was used as the primary criterion of wetting. Coating the carbon fibers with Mo, SiC and TiB_2 had no influence on wetting up to at least 850°C. The contact wetting angles in all systems were almost identical at ~140°C. At 1100°C the Al+12% Si matrix wets the carbon fiber and penetrates quite well regardless of the type of coating applied. Chromium coating of carbon fibers assures good wetting at 850°C. Figures 2; references 9: 8 Russian, 1 Western.
[155-6508]

UDC: 539.216.2:535.211

CALCULATION OF HEATED LAYER THICKNESS IN SUBSTRATE UPON LASER HEATING AND EVAPORATION OF FILM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 7 Feb 80) pp 21-24

VEYKO, V. P., KRUTENKOVA, Ye. A. and YURKEVICH, B. M., Leningrad

[Abstract] The thickness of the layer of substrate which undergoes structural or phase changes upon complete destruction of an overlying film by a laser beam is determined. A specimen consisting of an absorbing film applied to a nonabsorbing substrate was acted upon by a pulse of laser raidation from the direction of the film. During the pulse the film is completely evaporated and the substrate is heated by conductivity. During the cooling period, the temperature in the substrate is further redistributed. Due to the mathematical difficulty of the problem, which requires successive solution of differential equations for heating, melting and evaporation of the film, several simplifying assumptions were made, including that the temperature at the boundary between substrate and film is known during irradiation. The results of the calculation agree rather well with experimental data. Figures 2; references 6: 5 Russian, 1 Western.
[155-6508]

UDC: 621.785.5

METAL FOIL DAMAGE IN FLOW DISCHARGE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 7 May 80) pp 17-20

BABAD-ZAKHRYAPIN, A. A. and SAVVATIMOVA, I. B., Moscow

[Abstract] A study is made of the effect of glow discharge plasma ions on niobium and palladium foils. The metal foil was placed on a cathode with a circular shield protecting a portion of the foil surface from direct exposure to the discharge. A foil surface of ~1 square meter was left unprotected. The glow discharge between the cathode and anode was excited in a medium of high purity helium at 10^3-10^4 Pa. The discharge voltage varied from 300 to 1000 V, current density 10 to 50 mA/cm^2. The glow discharge power heated the cathode to 600-1500°C. It was found that treatment of the metal foils caused significant damage. The surface bulged and chains of pores appeared beneath the surface. The degree and size of the bulge depend on the treatment temperature and dose.
[155-6508]

UDC: 669.27:539.4.019.3

PRIMARY DAMAGE STRUCTURES IN TUNGSTEN BOMBARDED WITH ITS OWN IONS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 9 Apr 80) pp 12-16

BABAYEV, V. P., ZABOLOTNYY, V. T., LAZORENKO, V. M. and MAKHLIN, N. A., Moscow

[Abstract] An electron microscope study is presented of the structure of primary damage in tungsten bombarded with its own ions at a temperature corresponding to stage II of annealing, and results obtained with a transmission electron microscope and autoion microscope are compared. Specimens from a tungsten single crystal were bombarded in a heavy ion accelerator at 50 and 700 keV. The bombardment temperature was 300°K for the autoion microscope and 363°K for the transmission electron microscope specimens. Bombardment doses varied from 10^{11} to 10^{15} per square centimeter. The overwhelming majority of defects detected in transmission electron microscope studies are interstitial dislocation loops. It is found that impoverished displacement cascade zones do not tend to change to subtraction dislocation loops at the bombardment temperature corresponding to stage II annealing or during post-radiation annealing at stage III or higher temperatures. The overlap of displacement cascades leads to saturation of bombarded specimens with interstitial atoms. Chains of focusing substitution largely determine the nature of the energy and dose dependence of the volume and structure of damage zones produced by displacement cascades. Annealing in stage III occurs due to migration of vacancies to the surface or other sinks, though the vacancies show no great tendency toward precipitation on dislocation lines.
[155-6508]

UDC: 621.315.592

DAMAGE CAUSED BY LASER RADIATION IN CADMIUM ANTIMONIDE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 30 Jul 79) pp 8-11

NOVIKOVA, A. A. and ZAKHARUK, Z. I., Chernovtsy

[Abstract] A study is made of the changes in cadmium antimonide crystals upon exposure to ruby laser radiation. Single crystals of both n and p type were grown by the zone melting method and cut into several batches of plate specimens 0.5 mm thick. The plate surfaces were polished both mechanically and chemically. The specimens were irradiated in air at room temperature in the free generation mode. It was assumed that the energy was

absorbed in the surface layer. At high energy densities (around 80 J/cm^2) a deep crater was formed. Decreasing the density to 20 J/cm^2 decreased crater depth, and caused a conical elevation to appear in the center of the crater. Further decreases caused the crater to disappear, the conical elevation becoming higher. At 0.7 J/cm^2 the surface simply became wavy. At 0.1 J/cm^2 no visible traces of laser radiation were produced. The type and extent of damage depends not only on radiation energy density, but also on crystallographic orientation and preliminary treatment of the crystal surface. Chemical polishing and orientation in the (100) plane are necessary to produce quality p-n junctions in CdSb:Te semiconductors. At the energy at which p-n junctions are formed in n-CdSb, defect location anisotropy is observed. It is established radiographically that phase conversion of the surface layer structure does not occur upon formation of p-n structures in n-CdSb by laser radiation. Figures 2; references 8: 6 Russian, 2 Western.
[155-6508]

UDC: 535.211

RATE OF SURFACE OXIDATION OF METALS HEATED BY LASER RADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 82 (manuscript received 1 Jun 81) pp 3-7

BURMISTROV, A. V. and KONOV, V. I., Moscow

[Abstract] Laser oxidation of copper is used to investigate the possibility of applying handbook reference data on oxide film growth kinetics to the description of laser action. Thermally thin copper specimens were heated by CO_2 laser radiation at 10.6 μm wavelength in earlier experimental studies, the data of which are used to determine the diffusion constants by a dynamic method, improved by considering heat losses of the specimen, ignored in earlier works. The reaction rate which occurs upon laser oxidation is approximation two orders of magnitude higher than the Wagner rate corresponding to isothermal conditions. This may be related to accelerated diffusion of the reaction components across crystalline grain boundaries and microscopic cracks formed in the oxide film upon unsteady radiation heating. Figures 3; references 6: 5 Russian, 1 Western.
[155-6508]

UDC: 669.4'76-156:548.7

STRUCTURE AND PROPERTIES OF RAPIDLY QUENCHED Pb-Bi ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 82 (manuscript received 3 Sep 81) pp 93-98

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[Abstract] A study is presented of the microstructure, phase composition and several other properties of Pb-Bi alloys after quenching from the liquid state under various conditions. The alloys were made of initial elements with over 99.9% purity by mass in resistance furnaces in corundum crucibles under purified argon. The alloys were quenched from 423-1273°K at cooling rates of 10^4-10^8 K/s (calculated) by centrifugal throwing onto rapidly rotating massive metal disks at 77 to 293°K. The alloys were heat treated at 323 and 373°K for one half to 100 hours in evacuated quartz ampules. The amorphous state was not fixed by rapid cooling. Metastable compounds are formed only upon super-rapid cooling to liquid nitrogen temperatures and are unstable upon tempering. Extremely rapid cooling to 293°K results in an increase in the mutual solubility of the components, shifting of the ε phase components from 27-42 to 27-50 at.% Bi, a sharp reduction in the size of the structural components and related changes in properties. Figures 5; references 10: 3 Russian, 7 Western.
[156-6508]

UDC: 669.245'26:669.018.45

INFLUENCE OF LANTHANUM, YTTRIUM, TITANIUM, ZIRCONIUM AND BORON ON HIGH TEMPERATURE PROPERTIES OF CHROME NICKEL ALLOYS IN VARIOUS MEDIA

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PRIDANTSEV, M. V., MATVEYEVA, M. P., LAZAREV, E. M., MOROZOV, V. A. and SAMARINA, A. M., Moscow

[Abstract] The alloys used in this study were melted in an arc furnace with nonconsumable tungsten electrode on a copper water-cooled base in an atmosphere of purified helium. The oxidation of the doped alloys at 800°C is described by an exponential rule with exponent n=3.5 (zirconium, boron, yttrium) or a logarithmic rule (titanium and lanthanum). At 1000°C, oxidation of alloys with titanium and zirconium is described by a quadratic parabola, that of alloys with boron and yttrium by a cubic parabola, and oxidation of the alloy with lanthanum by an exponential rule with n=3.7. Doping greatly decreases the rate of oxidation in air, particularly at the higher temperatures. Rare earth metals are most effective. Heat resistance of chrome nickel alloys is higher in the combustion products of natural gas

than in air. The scale formed in air consists of chromium oxide. High-chromium alloys are more heat resistant in the combustion products of fuel oil than industrial heat resistant alloys. Doping with boron, lanthanum, yttrium, titanium and zirconium significantly increases the ductility of 40% Ni plus 60% Cr without significantly decreasing heat resistance. Figures 5; references 27: 20 Russian, 7 Western.
[156-6508]

UDC: 621.793:669.27'849

PRECIPITATION OF W-Re ALLOYS FROM MIXTURES OF THEIR HEXAFLUORIDES WITH HYDROGEN

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 82 (manuscript received 1 Sep 80) pp 27-31

LAKHOTKIN, Yu. V. and KRASOVSKIY, A. I., Moscow

[Abstract] Alloys were precipitated by the heterogeneous reaction of joint reduction of tungsten and rhenium hexafluorides by hydrogen with the formation of a precipitate and volatile hydrogen fluoride on the inner surface of a direct-flow copper reactor 5 mm in diameter at 450 to 800°C. The total pressure of the reaction mixture was 15 mm Hg, hydrogen flow rate 330 cm^3/min, tungsten hexafluoride flow rate 25 cm^3/min, and rhenium hexafluoride flow rate 1.25 to 6.25 cm^3/min. After precipitation of the metal the copper tube was dissolved in dilute nitric acid, the sediment was cut into sections which were weighed on an analytic balance and the distribution of the sediment over the length of the reaction zone was constructed. The rate of rhenium sedimentation was found to be controlled by diffusion of rhenium hexafluoride to the substrate at 450-800°C. Rhenium was found to significantly increase the rate of crystallization of tungsten when both were present, the relative rate increasing with decreasing substrate temperature and increasing rhenium content. Studies of the morphology of the alloy growth surface showed that liberation of an A-15 structural type phase in the solid solution matrix with a rhenium content of 9% changes the mechanism of acceleration of the tungsten crystallization process. A mechanism is suggested. Figures 4; references 7: 4 Russian, 3 Western.
[156-6508]

UDC: 546.47'231:535.343.2

STRUCTURE OF SHORTWAVE EDGE OF LATTICE ABSORPTION BAND IN ZINC SELENIDE WITH ALUMINUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 18, No 6, Jun 82 (manuscript received 4 May 81) pp 895-898

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[Abstract] A study is made of the lattice absorption of ZnSe:Al in the 500-800 cm^{-1} interval resulting from the presence of aluminum in the crystal. Studies were performed on crystals obtained in an earlier work. A group of absorption bands is found related to twice the frequency of local oscillations resulting from defects in the zinc selenide lattice related to the presence of aluminum. The contribution of this absorption mechanism near $10.6 \cdot 10^{-6}$ m is the same order of magnitude as multiple lattice background absorption for an Al concentration of not over 10^{23} m^{-3}. Figures 4; references 7: 1 Russian, 6 Western.
[159-6508]

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